# ELECTRICAL REVIEW

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### VIEWS, NEWS AND INTERVIEWS.

A Chicago electrical supply house has offered $600 for the first coin minted of the souvenir half dollars which will be struck off for the World's Fair.

The telegraph and telephone were invaluable aids in assembling our citizen soldiers during the railroad strike last week. Officers and privates were summoned by telephone from their homes and their clubs, and those enjoying vacations were reached by telegraph.

The telephone companies of the Pacific coast have been, and are now, spending a great deal of money in extensions and underground work.

The village of Ogden, N. J., now known as Edison, has been built up within the last two years. The site is at an old iron mine, known as the Ogden mine. It was abandoned many years ago, and until two years ago the vicinity was entirely deserted, and had grown up with shrub oaks and bushes. When Mr. Edison invented the magnetic ore separator, he organized the New Jersey and Pennsylvania Ore Concentration Company, and a plant was established at Ogden, the name of which was then changed to Edison. The ore as taken from the mine is run through enormous crushing machines, and then passed through the Edison separator, where powerful magnets attract all the metal, which is afterwards run into pigs.

The new Armour packing house, at Kansas City, will be finished by the middle of September. All the processes of killing, carrying and handling the beef carcasses will be done by electric and pneumatic power.

It is only the married man who does not appreciate a telephone in the club house.

Prof. Edwin J. Houston thinks that the recent severe, protracted hot weather that existed in the central and eastern portions of the United States during the latter part of July formed, in all probability, but part of various general phenomena produced by profound solar disturbances. He also judges that the thermometer in Mars has been up to red heat, and from this planet's close proximity to the earth we have shared its warmth.

William M. Evarts once remarked: "Columbus said: 'Here is one world—let there be two'; but Cyrus W. Field said 'Here are two worlds—let there be one.'"

Mr. Charles A. Coffin, president of the General Electric Company, will sail for Europe. Mr. Coffin has labored loyally day and night for the success of the great interests he controls, and finds the arduous work of the past few months telling on even his great vigor and excellent health, and he very sensibly lays aside toil for a brief rest. The resemblance of Mr. Coffin to Senator Hill, of New York, has often been noted, and, like the senator, Mr. Coffin is a gentleman of most temperate habits and pleasant demeanor, working quietly and thoroughly along the line of success in any task he undertakes. Mr. Coffin is reputed to be worth $2,000,000.

### Avoidance of Telephonic Disturbances Caused by Tri-Phase Power Currents.

Dr. Behm-Eschenburg has lately published in the *Electrotechnisher Zeitung* some valuable statements and experiments bearing upon the much mooted question how telephonic disturbances, caused by the tri-phase power currents, may be avoided, or at least reduced to a minimum effect.

FIG. 1.—SUBMARINE SEARCH-LIGHT USED IN SEEKING FOR THE LOST "HUSSAR" TREASURE.

The matter was called to his attention by complaints received from telephone subscribers of Zurich and the surrounding country. As is well known to the readers of the ELECTRICAL REVIEW, there is a tri-phase current installation at Killwangen, a city about 20 kilometres distant from Zurich, which installation produces power and light currents utilized in Zurich and its suburbs. At Killwangen the tension of the current at the binding posts of the dynamo is but 50 volts, and, by means of suitable apparatus, this voltage is transformed to 3,000. Thence the high tension current is transmitted to sub stations at Zurich and the surrounding country. At each station there are several transformers which produce currents of low voltage used for driving motors or lighting buildings.

As soon as the Killwangen installation started work, every telephone subscriber situated in the neighborhood of the private telephone line serving to interconnect the power station at Killwangen with its various sub-stations complained of disturbing noises, seriously interfering with the proper use of his apparatus.

These disturbances became much more severe when the air was saturated with humidity.

This well authenticated fact led to the belief that the disturbance was caused by a direct leakage of the power current into the adjacent telephone lines. It should be noted that at Killwangen the neutral point, both of the primary and secondary of the transformers, was grounded, likewise in sub-stations employing the current for lighting purposes. On the other hand, the neutral point of low voltage currents was grounded at all stations serving to drive motors and similar machinery.

Upon experimentation the following facts were brought out:

An interruption in light stations of the ground connection of the transformer produced absolute silence in the telephone apparatus at such station, while the noise continued at all others, but by cutting the ground connection at these stations all noise disappeared. A similar result was achieved by discontinuing the ground connection at the principal station at Killwangen.

From these tests, Dr. Behm-Eschenburg inclines to the opinion that the disturbance to the telephonic apparatus was caused by a direct leakage from the power current conductors, the earth forming one part of the line.

It will also be remembered that Dr. Wietlisbach (Bern) has experimented upon this line. The result of his work may be condensed in the following statement:

Dr. Wietlisbach apparently believes that the laws of Ohm and Kirchhoff do not apply to alternating currents, because he assumes the existence of difference in phase in the outgoing and return conductor of a simple alternating current, which differences depend upon the introduction of transformers into the line. Again, he does not think that at each moment the algebraic sum of all currents in the three conductors equals zero.

It should be stated that in the above-mentioned article Dr. Wietlisbach has taken no account of the electrostatic capacity of the line. Dr. Behm-Eschenburg, however, inclines to the belief that the observed leakage of current into the telephone lines depends upon the electrostatic capacity of the respective telephone lines.

FIG. 2.—DIVER TIBBETTS READY TO GO OVERBOARD WITH THE SEARCH LIGHT.

"The Complete Electric Railway Directory" is the latest collection of statistical information on this interesting subject. It is compiled by Mr. A. H. Chadbourne, of Philadelphia, and is as reliable in its facts as painstaking research can make it.

### A SUBMARINE SEARCH-LIGHT.

#### The Electric Light Called to the Diver's Aid in the Search for the Golden Treasure of the Lost "Hussar"—Captain Symonds, of the Dredge "Little Giant," Believes in the Efficacy of the Light, But Doesn't Like Reporters.

BY STEPHEN L. COLES.

An East river boatman took me out in his yawl from Port Morris, N. Y., swung around into the swift running tide which makes in from Hell Gate, and headed for the steam dredge "Little Giant," lying anchored to the rocky bottom of the river in 70 feet of water, about 50 yards from the scraggy beach. A few jerky strokes brought the boat under the stern of the dredge, and, while the oarsman was holding her steady by grasping a cable, I inquired if Captain Symonds was aboard.

"Yes, he is," answered a gray-haired, sunburned old sea dog, "and what d'ye want? We don't allow nobody on board."

"But I'm from the ELECTRICAL REVIEW and I've got a letter from you saying you would be glad to show me your new submarine electric lamp," said I, as the boatman edged up to a good place for me to jump aboard.

While an animated discussion between Clerk G. W. Todd and the captain was in progress, as to the propriety of my coming aboard, I quietly sprang upon the deck of the dredge and motioned the boatman away I was now, figuratively speaking, between the devil and the deep blue sea, and it looked for a time as if it was a case of "sea." The captain was mad, not at me in particular, but at the *genus* reporter in general. He had received a call from 15 newspaper men at one time, a day or two before this, and he had just finished reading the several stories of their visit. He didn't like the stories and, besides, the cook had given him huckleberry pie for breakfast that morning, and the pie "hadn't no kiver onto it, dang the cook." So, perhaps the captain's lack of cordiality may be excused on the ground of unpleasant reading and an uncovered pie.

"Ain't you fellers got nawthin' better to do, than to come raound here with yer spectacles and yer pencils a-tryin' to make yer bread and butter outen us poor folks? That's why ye pester me, it butters yer bread fer ye; and if it made the bread sour, ye bet ye wouldn't be botherin' raound here," was the captain's parting shot, as he returned to some repair work he was doing. It was very warm, but interesting, on the "Little Giant."

This outfit (the dredge and the captain) is working in the interests of the Little Giant Hussar Wrecking Company, capital, $15,000, which was organized a short time since, to search for $4,800,000 in golden guineas which went down over a century ago in the "Hussar." This was a British ship sent from England to the United States, with money to pay off the British red-coats during the Revolutionary war. While sailing up the East river a storm arose, the "Hussar" became disabled and the officer in command decided to beach his ship and save the money if he could. Selecting the Port Morris shore,

he turned the "Hussar's" bow toward it and struck head on. The ship slid back off of the narrow ledge forming the beach and sunk in 70 feet of water, where her remains are now supposed to be. Several attempts have been made to recover the lost treasure, and, indeed, a casket of jewels, some silver plate and a number of the golden guineas were found some years ago. But the bulk of the money has never been raised. Captain Symonds has brought up old gun flints, chunks of lead, three guineas and other relics which lead him to believe that the "Little Giant" is now anchored over the place where the "Hussar" went down. Time and the tide may have buried with rubbish or carried completely away the coveted guineas, but Captain Symonds and his backers are full of faith. The captain has hunted for hidden treasure before and knows how such work ought to be done, too. A New Englander once hired him to dredge in a little creek for some of Captain Kidd's lost treasure. The treasure was not found, but, as Captain Symond's got his pay every night, he was satisfied, if his Yankee friend was not.

Clerk G. W. Todd, the captain's private secretary, was more affable and consoled me with the remark that he guessed the Captain would kick if he was playing a game of football. Under Mr. Todd's protecting wing, I made a hurried inspection of the plant.

The "Little Giant" is an ordinary dredging boat equipped with an hydraulic dredge of great power, air pumps for the diver, an electric plant to furnish current to the submarine light and the usual paraphernalia of such outfits. The electrical apparatus is located in the stern and consists of a small dynamo and rheostat made by the Colburn Electric Manufacturing Company, of Fitchburg, Mass. The dynamo is run by an Atlas upright engine and generates 50 volts at 2,400 revolutions of the armature. It has a capacity of eight 16 candle-power lamps. A single circuit is carried on overhead cleats to a plug switch in the bow. To the switch is attached 100 feet of twin conductor, silk-covered submarine flexible cable, made by the Edison General Electric Company. At the other end of the cable is a water-proof socket into which is fitted a 65 candle-power, 35 volt Thomson-Houston incandescent lamp. This constitutes the search-light. The lamp has a flat carbon and a specially heavy round glass globe.

Diver M. O. Tibbetts, a typical "down Easter," told me that the water was kept constantly "riled up" by the swift running tide. His part consists in going down after the dredge has finished its work and reporting on the progress made. He has heretofore been able to judge of what has been accomplished only by the sense of feeling, as it is impossible to see anything in the turbulent water. The search lamp emits a translucent glow for a distance of 10 feet, and, when held down below the diver's knees, throws a good light on objects above it. Diver Tibbetts goes down in his heavily weighted dress, feels around carefully with his feet and one hand, and when he touches anything worthy of investigation brings the lamp close to it and inspects it.

The work is necessarily slow as it can be carried on only at flood tide. The ebb tide carries the hose connected to the hydraulic dredge into the iron jaws of the dredge and cuts it, so that it is rendered useless. Whatever is brought to the surface in the iron bucket of the dredge is dumped on a screen and carefully washed. In this way it is hoped to secure the treasure, as it is improbable that any great number of coins will be recovered at once.

Both Captain Symonds and Diver Tibbetts are pleased with the submarine electric light, and agree that it will greatly facilitate their work. The captain is having a reflector and guard, or "muzzle," as he calls it, made for the lamp, and hopes to increase its lighting power and defend it from breakage in this way.

After a while Captain Symonds came aft, and, sticking his head into the engine room, inquired, "What's the name of yer paper?"

"The ELECTRICAL REVIEW."

"Oh, I know it, I know it. It's run by this hyer 'lectrical society. They send you fellers around to git wind of the valyble experyments of poor folks, and then they goes off and makes the machines, and every feller in the society builds him a new house and let's the poor feller sweat fer his share. That's the way they do it.

"I know all 'bout this hyer 'lectricity business," continued the captain, softening a little. "I knowed the first feller who diskivered it."

"Who was that, Captain?"

"Nevermine his name. He got cheated out of all his rights and got killed in the war. I knowed him real well; yes, sir."

Clerk Todd called the boatman and, asking him to bid the captain a tender farewell for me, I departed for the dry land.

## Fire Alarm Telegraph Patent Suits Decided.

Four decisions were sent down by Judge Colt, at Boston, on August 11, in suits in which the Gamewell Fire Alarm Telegraph Company and the Municipal Signal Company were at issue.

The first suit, which the Gamewell Company wins, was brought by the Municipal Signal Company, and related to electric signal boxes used in a municipal signal system. The Municipal Company rested its case on a patent issued to John C. Wilson, which was for an apparatus in which a key given to a customer removed an obstacle from the signaling crank, and the signal

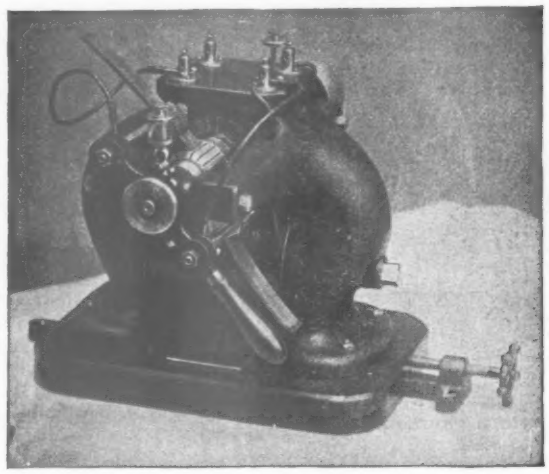


FIG. 3.—COLBURN DYNAMO, WHICH FURNISHES CURRENT FOR THE SUBMARINE SEARCH-LIGHT OF THE DREDGE "LITTLE GIANT."

was operated by turning the crank, whose handle projected through the side of the door. The special merit of the Wilson invention lay in controlling the locking device of the key by moving the door. In a previous invention, for which a patent, now expired, was granted to one Hotchkiss, the citizen's key operated directly the alarm mechanism. The court says: "I do not think a transmitting mechanism controlled by the key covers a transmitting mechanism operated directly by the key. In the defendant's apparatus the key operates directly the alarm mechanism, and for this reason does not infringe the Wilson patent. Upon this ground I must direct that the bill be dismissed with costs."

In the second suit the Municipal Signal Company was plaintiff and the Gamewell Company defendant, and the suit related to patents covering devices in the Municipal signal system. By this apparatus signals are conveyed by electricity to a central station from boxes located on the streets. The patent relied on by the plaintiffs was for a receiving instrument which simultaneously registers a message, records the time of its reception and sounds an alarm, the patent having been issued to one Ennis. The court says: "The first claim of the Ennis patent is for an apparatus which accomplished a result unknown in the art up to that time, and the defendants' apparatus accomplishes the same result through the same, or well known, or equivalent instrumentalities, and, therefore, their machine is within the Ennis invention. Decree for complainants."

The third suit was brought by the Municipal Company *vs.* Gamewell, on letters patent issued to one Noyes, March 22, 1887, on devices by means of which the reception of emergency signals at the main station is marked by the ringing of a bell, while in the case of ordinary patrol signals no alarm is sounded. The defence was that, by reason of prior patents and devices, there was nothing patentable in the Noyes apparatus. The court says: "I am still of opinion that this alleged prior invention has not been established by that clear and satisfactory proof which is necessary to invalidate the Noyes patents. Decree for complainant."

The fourth suit was by the Gamewell Company *vs.* the Municipal Company, and alleged the infringement of letters patent issued to Stephen Chester in June, 1875, relating to an improved form of signal box for the transmission of fire alarm or other electro-telegraphic signals. The court says: "A comparison of the defendant's signal box with the Chester box, with respect to the devices covered by the third claims, show such dissimilarity that there can be no infringement. Bill dismissed with costs."

## Mexican Telephone Company.

The Mexican Telephone Company has purchased the lines, offices, furniture, etc., complete of the Mexican Northern Telephone Company and the Mexican Central Telephone Company.

The Northern Company controls the telephone exchanges in the cities of Monterey, Saltillo, Nuevo Laredo and one or two others. The Central Company owns the telephone lines in Queretaro, Guanajuato, Leon, Zacatecas and San Luis Potosi.

All these exchanges are now added to the list of the Mexican Telephone Company which already has control of Mexico City, Tacubaya, Vera Cruz, Merida, Progreso, Oaxaca, Puebla and Guadalajara.

Mr. Torbert, the general manager of the company, has been instructed to at once take possession of the new exchanges and take an inventory of the stock received. He has now about 20 cities to look after, his duties as general manager by these recent purchases being doubled.

Mr. Torbert will leave in a few weeks for the State of Sinaloa to establish telephone exchanges in the cities of Mazatlan and Culiacan. Later, he will continue the work of extension in other cities in the Republic.

## Western Union.

It is stated that those who are banking on a stock dividend in Western Union Telegraph are likely to be disappointed, as none is contemplated. Many improvements are contemplated in the near future, says the Boston *News Bureau*.

For instance, the business of the Chicago office has grown to such enormous magnitude that the present quarters are wholly inadequate to properly transact it. The company is in the market for another structure, and if a desirable one can be found its cost, including necessary alterations, is estimated at at least $1,500,000.

It is deemed advisable to purchase a building outright, as it is highly important that it should be completed in time for the World's Fair. This would be impossible if an attempt was made to put up a new building. When the purchase is made it will be on a cash basis—that is, a check for the full amount will be given.

Other plans even more ambitious than the one above mentioned are being considered, the carrying out of which will require considerable ready money.

## ELECTRICAL PEOPLE WE MEET.

Mr. Geo. A. Redman, of Rochester, N.Y., a pioneer in electric lighting, was in the city last week, endeavoring to do three weeks' work in as many days. There are many energetic fellows like Mr. Redman who don't allow for distances and Summer absenteeism, who find that the metropolis can't be covered in as brief time as intended. Mr. Redman is general superintendent of the electrical department of the consolidated lighting companies of his city, the new company having been named the Rochester Gas and Electric Company, possessing a capital of $2,400,000. The consolidation includes the Brush Electric Light Company, the Rochester Electric Light Company (United States system), the Edison Electric Illuminating Company (Thomson-Houston arc and Edison incandescent), and the Rochester Gas Light Company. The company has three water power stations and one of steam, and operates 14,000 incandescent lamps, 2,300 arc and 1,000 electric motors, besides the gas plant. The new company includes all lighting privileges of the city, and the electrical department under Mr. Redman will be second to none in the country.

Mr. Chas. A. Hamilton, the head and front of the Bridgeport Brass Company, is one of the most successful of New England's young business men. Formerly on the staff of the widely known plating house of Rogers & Brother, at Waterbury, he there acquired an acquaintance with business that proved most valuable to him in assuming the highly responsible position made vacant in the Bridgeport company through the protracted illness of the universally esteemed Col. Fred. A. Mason. Mr. Hamilton has other interests of importance, being a partner in the Rogers & Hamilton plating house, of Waterbury, and is an active, alert, fine-looking and progressive man. His father, Captain Hamilton, is president of the Rogers Company at Waterbury, one of the pioneer plating establishments of the country, and is a hale and hearty gentleman who enjoys the competition of his son's plating house, and admires his pluck and enterprise in starting in business independently. It is related of Captain Hamilton that he gave a job to a colored polisher some time ago, and was immediately waited on by the foreman of that department, who stated that one of the men, naming him, would leave should the colored man be put to work.

"He needn't wait," said Captain Hamilton, who earned his title fighting to put down the rebellion and free the slaves. "Tell him he can quit work this hour, and come to me and get his pay."

The man quit, remained out one week and then begged for re-instatement, which was granted, and there were no more complaints about the colored man, who proved to be an excellent workman.

Dr. George H. Benjamin, the electrical expert, is spending the hot months in Europe. The doctor has recently increased his worldly possessions to a very considerable extent, but this makes no difference in the amount of work he does, and a rest abroad he found necessary and wisely took it.

Mr. William Henry McKinlock, president of the Central Electric Company, of Chicago, is spending a brief vacation with his family at Narragansett Pier. Mr. Wm. A. Jackson, of Detroit, is with his family at the same popular resort. These two gentlemen were for a number of years most pleasantly associated in business as officers of the Detroit Electrical Works. Mr. McKinlock afterwards started in business for himself, organizing the Central Electric Company and building up a magnificent business and establishing a credit second to no electrical house in progressive Chicago. Mr. Jackson has to some extent withdrawn from active telephone and manufacturing duties, and is enjoying a rest after years of hard and important electrical work. He is universally esteemed and possesses qualities of mind and heart that strongly endear him to all who possess his acquaintance.

BI-POLAR.

### General Electric Company's Diamond Drill.

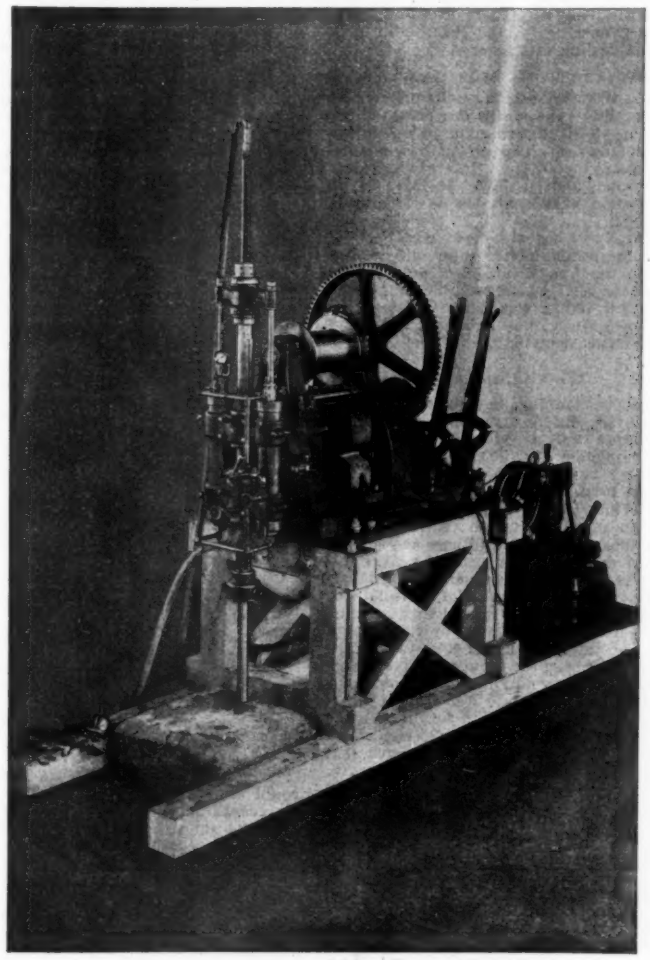
The application of electricity in mining operations has caused in recent years the evolution of many new and perfected pieces of apparatus. One of the most important of these, the drill, has formed the subject of long and special attention on the part of electricians and mining engineers for a considerable time past, on account of its almost universal use in the mining industry. None of the designs, however, has hitherto fully responded to the demands of the miner. The General Electric Company has just perfected a new diamond drilling machine for which is claimed a superiority over any others yet devised. The novelty of its construction should recommend it to the attention of mining superintendents and engineers intent on operating their mines with greatest considerations of economy and facility.

The drilling apparatus is shown in the illustration mounted upon a heavy timber frame. Behind this the electric pump supplying water to the drill, and having a capacity about 700 gallons per hour against a pressure of 150 pounds to the square inch. It also supplies water to the hydraulic cylinders of the drill as well as the drill rod. Valves are set in the pipes leading to the pressure cylinder, so that any desired pressure may be put upon the drill bit. A valve also controls the supply of water to the drill rod, the pump being able to supply an ample amount to keep the cutting rim of the bit perfectly free and clean. The drill head is arranged with a heavy hinge, so that, when uncoupled from the drill rod, it may be swung away from the frame, and allow room for hoisting the drill rods from the hole. Here, also the machine shows its complete fitness for this work, for at the top of the main standards of the iron frame is arranged a small hoisting drum, which, by the simple movement of a lever is geared to the armature of the motor, and the machine is ready, with the aid of a block and fall, to hoist out its own drill roads. In the experiments which were made with one of these drills at the factory, the drill, under a pressure of 120 pounds per square inch on the pistons of the pressure cylinders, bored through 12 inches of solid blue granite in three minutes. Under a pressure of 75 pounds the drill cut through 12 inches in six minutes, and at a pressure of 35 pounds it cut through the same amount in about 16 minutes. These cutting speeds were made with the drill bit and short barrel coupled directly to the drill head, and will necessarily be slightly diminished when a considerable length of rod has been driven into the rock, but they are sufficiently conclusive to show that the even motion of the electric motor makes it the ideal power for this work. The satisfactory performance of the drill apparatus under the stringency of the different tests to which it was subjected leads us to predict its wide adoption in the mining world.

### Combined Switch and Fuse Box for Railway Lighting Circuits.

The accompanying cuts illustrate a very neat combination switch and fuse box for use on the lamp circuits of electric street railway cars. Fig. 1 shows the box complete with the switch handle in place, Fig. 2 the body of the box with the rotating ratchet switch in the lower compartment, and Fig. 3 the reverse side of the cover with the terminals and thumb screws for the metal fuse. This box is claimed to possess many advantages over anything heretofore in use for railway lighting service. It is very compact, neat, and, as it is made entirely of porcelain, perfectly incombustible. The switch is of the latest improved type of rotating ratchet switch manufactured by the General Electric Company, and possesses the essential points of good contact and sudden break. The fuse is placed on the inside of the cover so that in replacing a blown out fuse the fuse terminals are taken completely out of the circuit, and it is utterly impossible to receive a shock in any way. The brass clips on the cover fit over the two contact posts in the box, and serve the double purpose of holding the cover in place and forming part of the circuit.

As will be seen in Fig. 2, the box is divided into two parts, the lower holding the switch and the terminals for the wire, and the upper part consisting of a shallow recess into which the thumb screws on the inside of the cover project. In the back of the box behind this upper recess is a magnetic blow out, which breaks the arc formed when the fuse is blown. In general appearance the box is quite ornamental, and with its great superiority over other and older devices for the same purposes it should commend itself strongly to all street railway men.



General Electric Company's Diamond Drill.

### West End Street Railway Company.

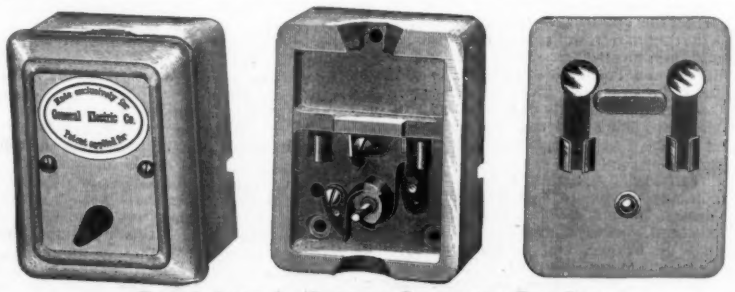
Why Boston will put $10,000,000 at a time into a Western railroad and say nothing of it, but let it alone to grow, and yet will overlook home roads and home industries making even better returns, is well illustrated in the case of the West End Street Railway Company, says the Boston *News Bureau*. A bright broker says West End common would have sold at 80 had not the company begun to tear up Washington street and repair tracks in Boylston street. Everybody sees the work being done and is scared of the cost. Of course there would be no such scare if West End rails were on the prairies. The West End Company is spending $50,000 a month for track repairs and charging the same to expense, but these tracks carry a traffic returning above $500,000 per month. A nickel is next to a cent in our popular coinage, but multiplied by the daily travel of thousands it makes a very respectable sum.

The New York & New England and the West End Street Railway Company earn about the same amount of money, gross and net; one-half the Wet End's net is given to holders of its $9,000,000 common stock in 10 per cent. dividends, and the cash market value of this stock is only about $13,000,000. All the net of the New England road goes to pay charges ahead of its $20,000,000 common stock, which yet sells for about $8,000,000 cash value in the market.

New England has great consolidation possibilities; West End has consolidated and has greater earning possibilities than New York & New England ever can have.

The West End could show great figures of gross and net earnings if it so elected, and probably some day it will do so; but at present it may be said as to track repairs and new rails, that under the decision of the railroad commissioners there can be charged to construction only $7,500 per mile for rebuilding of old roadbeds and the putting in of heavier rails, and whatever may be the cost of rebuilding the Washington street tracks it must all go into expenses, except $7,500 per mile, by reason of the additional weight of the rail over the old rail. The rail now being put down is a heavy, grooved, steel rail, from Youngstown, with the metal chairs which connect the rail with the timber electrically welded to the rail, instead of being in separate pieces and bolted as in the old rails.

The wonder is that West End can make such liberal charges to expense and continue its dividends, but the books of the company show that it is doing it.




Figs. 1, 2 and 3.—Combined Switch and Fuse Box.

### The Telephone in Belgium.

Mr. Conyngham Greene of the British Legation in Brussels has lately written a report on the history and progress of telephone enterprise in Belgium, from which it appears that up to 1883 the telephone service in that country was in the hands of private companies, and the uncertain character of the concessions granted by the State checked the free expansion of private enterprises, says the *London Times*.

Between 1880 and 1883 three separate telephone systems were in operation in Brussels, but, owing to competition and the refusal of the companies which worked the lines to grant mutual subscriptions over the lines of their rivals, no great success was obtained by any of them. In 1883 the State Department of Posts and Telegraphs took the initiative in organizing and developing the telephone system of the country.

A law was then passed authorizing the government to undertake themselves, or to concede on fixed conditions to others, the establishment and development of telephone lines. The uncertain and temporary character of the previous concessions gave place to a certain and regular system, and the effect was immediate. In a few months the Bell Telephone Company bought up the two rival companies of Brussels and secured a concession, not only for the Capital itself but also for Ghent, Antwerp, Verviers and Charlerot.

The company started with a paid-up capital of £105,400, of which more than two-thirds was devoted to buying up the rival plant and apparatus and replacing that which was worn out and inefficient. The existing wires were replaced by phosphor-bronze wires on the Montefiore system. Owing to the superior capability of this wire for bearing a strain, it was found possible to diminish the number of supports, and thus to get rid of much useless material. Moreover, the expense of repairing the wires was materially reduced, as breakages were of very rare occurrence and the interruption of the service proportionately unusual.

By way of dividend the company distributed in 1889 among its shareholders £10,750 and £15,191 in the following year, while the number of subscribers rose from 4,051 on December 31, 1888, to 4,726 in 1892. The State has also laid and worked lines of its own to the less important centers which were somewhat neglected by the companies. A system of receiving and transmitting telegrams by telephone to subscribers has been introduced and has proved a great success.

At present the repurchase of all the telephone concessions by the State is impending, and will probably take effect from January 1 next, when a further large extension of the telephone system will take place. The Belgian experience is that the telegraph and the telephone do not injure each other, but that both systems must be in the same hands to enable the universal extension of the telephone system to pay.

It appears, however, that in regard to press messages between Paris and Brussels the telephone has wholly supplanted the telegraph, and the same is true to a large extent of press messages generally. The head of the technical department of the Belgian telegraph and telephone services stated the principle of successful administration to Mr. Greene in these words:

"The telegraph and telephone service must be one great monopoly and that monopoly must be in the hands of the State."

### Popularity.

Popularity commercially is as desirable as popularity in social life. How men strive to attain this distinction in both spheres! There are men and goods that have all the elements of popularity within themselves but lack the qualities necessary to show forth their value. A combination of all these requisites renders success certain. We are glad to learn of the continued popularity of the "Ward" lamps. These same have deservedly popularized themselves as commercially successful, and a recent order for the installation of 268 "Ward" lamps in the Mechanics' Fair building, Boston, is an indication of the extent of their popularity.

## Problems of Commercial Electrolysis.

READ BY J. SWINBURNE, BEFORE THE INSTITUTION OF ELECTRICAL ENGINEERS, LONDON.

(*Concluded.*)

Electrolysis may also be employed for refining crude copper. In this case the process is simplicity itself. The crude copper is made into anodes, and thin plates of fine copper are used as cathodes, the electrolyte being sulphate of copper. Pure copper is deposited on the cathodes, and the impurities and the silver and gold are left in the mud, and the precious metals are extracted in the ordinary way. It is usual to employ cast anodes and arrange the plates in each vat in parallel, the vats themselves being coupled in series. This arrangement is clumsy and should be modified. I have had an opportunity of examining the large copper refinery at the Bridgeport Copper Works, and it may be well to describe the arrangement employed there. As the books were examined by Mr. J. H. Hays at the same time, I am also able to give you the actual cost of the process, without having too roseate a view imparted by an enthusiastic inventor. The refinery is arranged and worked in accordance with the patents of Mr. E. S. Hayden. The departures from ordinary practice are made with the view of reducing the amount of copper under treatment and of keeping down the cost of labor.

The anodes, instead of being thick cast copper, are sheets of thin rolled metal. The cost of rolling is small and the plates used can thus be made thin and dissolved very uniformly. Each vat contains a number of plates arranged vertically and across the vat. At one end a thin plate is supplied as a cathode. The first plate is made the anode, and copper is eaten off one side of each plate and deposited on the plate next to it. The result is that each vat acts as a number of small vats arranged in series and requires only two electrical connections. The whole question of large leads and connections is thus solved. There is almost no waste through partly consumed anodes, as the whole plate is eaten away evenly. The process is carried on until the whole of the anodes are eaten and their place taken by the pure deposited copper. The plates are hosed and removed, and the slime is treated to recover the silver and gold. The product is the highest grade of copper in the market and fetches £6 10*s.* a ton above "tough cake," or £4 10*s.* above "best selected." Silver and gold are completely separated without loss, and as 35 oz. of silver and one-half oz. gold per ton are allowed as tare, any copper containing more than that yields £8 per ton in bullion. Argentiferous copper thus yields at least £14 10*s.*, leaving the gross profit of £12 10*s.* at present rates. I have here taken the cost of refining at £2 per ton. The actual cost of refining copper depends on the output of the works and the cost of labor. In Bridgeport it came out just over £2 a ton. With modern dynamos and reasonably good engines and labor at English prices the cost would be a good deal less, say 20*s.* to 25*s.* per ton. The use of thin plates as anodes also reduces the capital investment in copper, which, as already pointed out, may be enormous, and thus lessens the margin to be allowed for fixed charges.

The Elmore process is too well known to require a full description. The copper is deposited on a revolving mandrel and burnished by a traveling agate burnisher. By this means copper tubes of great strength are made, and by cutting the tubes sheets are produced. Narrow strips can also be made, and these can be drawn down into high grade copper wire. A number of thin sheets can be made by depositing several separate coatings, one over the other, on the mandrel. The sheets separate when the tube is slit lengthways.

Writers of books on political economy are fond of saying that the chaffering of the market makes people manufacture in the cheapest way, and that the cheapest and best goods displace dearer and inferior qualities. They forget the interference of custom, ignorance and prejudice. If a new process is brought out it takes ages before it is taken up abroad and still longer before Englishmen will touch it. Here we have a process of refining copper at a gross cost of £1 or £2 a ton, with a gross profit of £13 or so; and yet copper refiners continue their barbarous methods. The first manufacturers to take up copper refining by electrolysis on really modern principles have a chance of making fortunes before the market is disturbed.

### ANTIMONY.

Little has been done in the way of treating antimony ores electrolytically. Dr. W. Borchers proposes to use the solution of sulphide in sodium sulphide as an electrolyte, and to deal with the ores. The specimens of antimony ore that I have examined have been perfect insulators, so that regulus of antimony cannot be used as an anode. There will be an accumulation of sulphur in the bath and it will probably insulate the anode. It is also difficult to say what material could be employed as anode in such a solution. Carbon would be attacked and platinum would be too expensive and other metals would be converted into sulphides. As the reduction of antimony, by iron, for example, is comparatively easy, there does not seem to be much opening for the electrolytic treatment in dealing with its ores.

### RECOVERY OF TIN FROM SCRAP TIN.

This, of course, can be readily effected by electrolysis. The scraps can be made the anode in an alkaline solution, in which iron is not attacked. Though such a method removes all the tin from the surface, it may leave some alloyed with the iron, as no doubt some tin sinks into the the iron during dipping.

Electrolysis has also been employed to assist in cleaning plates before dipping. I do not see how it can be of much service here, however. I have examined one of the processes, and it was said to be working very successfully, but I found the brushes had been accidentally left off the commutator.

### ELECTRIC TANNING.

Electrical tanning, though it depends on electrolysis, differs materially from all the processes already described in not depending on the isolation of radicles at the electrodes. Ordinary tanning is a very slow process, because it takes a long time for the tannin to diffuse into leather properly. If this substance is an electrolyte, it has a very complex molecule, and therefore diffuses very slowly. The outside of a thick piece of leather also becomes tanned, and to some extent protects the rest from the diffusion of more tannin. We may get an idea of what I suggest is the action in electrical tanning by regarding a hide as being made up of cells in groups, interstices among the groups. If the skin is merely left in tan liquor it takes months for the liquor to penetrate even into the interstices. It has then to diffuse through the walls of the cells. This is necessarily a very slow process, when it is remembered that the gelatine uses up the tannin as it comes in. Mechanical agitation has been tried, but it does not accelerate the process much. It is probable that agitation helps the liquor into the interstices, but of course it cannot help it into the insides of the cells, or, in fact, into those parts of the leather which are accessible by diffusion alone. The agitation can thus only perform the first part of the process—that is, getting the liquor into the pores that are open to it.

Passing electricity through the vats without agitation has also been tried, but it, again, is of little or no use by itself.

If, however, the skins are agitated and electricity is passed through the bath at the same time, the agitation circulates the liquid into the interstices, and the electric current sends the tannin through the walls of the cells, so that the leather is made infinitely faster than by the ordinary methods. Dr. Rideal and Mr. Trotter have made numerous and elaborate experiments on electrical tanning. The results of their work are given in the exhaustive paper read before the Society of Chemical Industry. I brought forward this as being probably the explanation during the discussion on their paper, and it agrees entirely with the results they obtained. The best results, according to this theory, would be secured by agitating the hides first to get the liquor into all the interstices uniformly, and then electrolyzing to get the tannin into the skin itself; then agitating to refresh the solution in the pores, and then electrolyzing, and so on. Messrs. Rideal and Trotter showed that this method does, in practice, give the best results. Leather made in this way also has a better chance of being uniform, because the outside is not acted on perceptibly quicker than the inside.

Tanning by agitation and electrolysis combined seems to have been invented by Messrs. Worms & Balé, and their process has been worked successfully for some time past in France, and in England by the British Tanning Company. Mr. Groth has developed a modification, and is also making leather by this process. Groth's appears rather better than ordinary leather, being more uniform in texture, and giving better results when tested for tensile strength. It is shown at the Crystal Palace Exhibition this year.

### OZONE.

Now that induction coils in the shape of transformers have become commercial, there is every reason to expect that ozone will be made industrially. Mr. Fahrig has already been making ozone commercially in this country. He employs an alternate current which works a transformer which gives a high electromotive force. Air is first drawn through an apparatus which is supposed to separate the nitrogen by diffusion. As nitrogen and oxygen have nearly the same densities, it is hardly likely that much nitrogen is separated. The air is then led through the ozonizers. These consist of piles of corrugated metal plates with sheets of celluloid between them. They are alternately positive and negative, being connected to the high pressure side of the transformer. There is thus an alternating discharge from the corrugated electrodes to the celluloid sheets, so that the air is ozonized on passing through.

Messrs Siemens & Halske employ ozonizers of the more usual form. Two concentric glass tubes are used. One electrode is inside the inner, the other is outside the outer tube. High pressure transformers are, of course, employed, and the air, or oxygen, is partly converted into ozone on its way there. Very little is known about the electrolysis of gases, if such an expression is admissible. The so-called silent discharge seems to work best, but the whole subject now demands quantitive investigation. The use of glass must involve low efficiency, as glass possesses the property of dielectric hysteresis in a high degree. We also want to know the current density and frequency which give best results. The arc and, in fact, many forms of electric discharge produce traces of nitrogen compounds. It is worth pointing out that if, under any commercial conditions, nitrogen compounds can be produced from air there would be an unlimited demand. A works situated on a waterfall would have its power and material provided, and the only cost of production would be the interest on plant and the wages of a man or two to look after the dynamos.

It has been said that chlorine acted on by the electric discharge is affected in the same way as oxygen. In the first place, chlorine is already quite a strong enough oxidant; and in the second, it is difficult to see how chlorine can form a allotropic modification.

### MISCELLANEOUS PROCESSES.

Under this head I have classed a few electrolytic processes whose theory is obscure, and about whose practical success there may be some doubt.

Mr. Webster has brought out an electrolytic sewage process. The effluent has electricity passed through it, and this is said to separate the solid material completely, and to kill all germs. Of course, when any sewage containing salt is electrolyzed, it produces chlorine or hypochlorites, and these would act on organic matter. Hermite, for instance, has applied his process to the disinfection of ships. This does not seem to be the basis of Webster's process, however, and there seems uncertainty as to what the action is supposed to be, and why the solid particles should be influenced by the current.

The next process is aging wine and spirits by means of the electric current. Whether there is really anything in this I do not know. Various inventors have brought out methods of aging liquors by electrolysis. There is uncertainty as to whether the result is produced, and as to how it is produced. Various deleterious alcohols might be oxidized into ethers, but it is strange that electricity should select just those that give a taste which is unpleasant to the human palate. Mr. Turell uses a direct, while M. de Meritens employs an alternating current.

The sterilization of milk by electrolysis is another process which is somewhat obscure.

### THE ELECTRIC FURNACE.

The idea of using the heat of the arc for producing high temperatures for such purposes as melting iridium is about a half a century old. Recently, however, we have had the Cowles furnace, used especially for the reduction of alumina. Properly speaking, this does not come within the scope of this paper, as there is no reason to suppose that electrolysis has anything to do with the reduction of the oxide. By pouring the power from a large dynamo into a carbon resistance, closed in so that the heat cannot readily escape, a very high temperature is produced. Alumina is then reduced by the hot carbon. It may be taken that at lower temperatures, such as those produced by ordinary furnaces, the affinity of aluminium for oxygen is greater than that of carbon, and that at the higher temperature the reverse is the case. It is not impossible, however, that the carbon in an ordinary furnace is inactive merely because it cannot get into good contact with solid alumina, and that in the Cowles furnace the alumina melts. In any case, there is no reason to suppose there is any electrolytic action going on.

The Cowles furnace is applicable to all processes which demand very high temperatures, such as the reduction of oxides of aluminium, magnesium, calcium, barium, strontium, silicon, chromium, boron, tungsten and manganese. Of course, many of these metals are not at present in demand; but, then, it must be remembered, that may be because there has, until now, been no way of making them reasonably cheap. Many, if not all, of these metals have been already obtained by the Cowles process.

It is a question of economy whether the Cowles furnace should not be employed in many other reduction processes which do not require such high temperatures. The furnace is efficient, as the heat is applied where it is wanted, and little is wasted by radiation or convection. We thus have to compare an ordinary furnace in which the heat is applied badly, and a great deal is wasted because the gases go off at a very high temperature, with a system which begins with an efficient furnace working a very inefficient heat engine and an efficient electrical machine. The electrical furnace will doubtless soon be applied in many cases, especially those which ordinarily involve inefficient furnaces, and retorts which break down quickly or leak.

The manufacture of phosphorus is a good example. On paper the process is simple. Bone ash, or tricalcic phosphate, is not reduced by carbon at ordinary furnace temperatures, so it is treated with sulphuric acid, and converted into monocalcic, or superphosphate. Making this involves making sulphuric acid, or buying it. Acid phosphate is then heated in retorts with carbon, and two-thirds of the phosphorus is obtainable theoretically. If sand is used it acts as a strong acid—or, rather, anhydride—at high temperatures, and all the phosphorus should be obtainable. The retorts, of course, give rise to trouble and expense. Messrs. Readman, Parker & Robinson, by employing the electric furnace, can deal with mineral phosphates, and require no sulphuric acid.

I do not know whether carbon at the temperature attained in the electric furnace will reduce calcium phosphate to calcium and phosphorus, or whether calcium phosphide is formed. With sand, of course, calcium silicate is formed. One might expect that this would be reduced to calcium and silicon, in which case it would be reasonable to suppose that the operation could be carried on without silica. It has been said that some oxides which can be reduced by very hot carbon when dealt with separately can form compounds that cannot be reduced if one oxide is strongly acid in comparison with the other. If that is the case, though the lime and silica might be reducible separately, the combination of the two, calcium silicate, might be irreducible. Whether calcium silicate is reducible or not, silica must, of course, be employed if the phosphate would otherwise be converted into phosphide.

It would be well to see what other reduction processes could be dealt with economically by the Cowles furnace. Doubtless there are many, and Messrs. Parker and Robinson are sure to explore the field pretty thoroughly.

### CONCLUSION.

A very few of the possible applications of electrolysis have been described in the foregoing paper, and the labors of many workers have been passed without mention. This was unavoidable. There is also another difficulty in writing such a paper as this: I have not worked at all on the processes myself, and have had to rely on published accounts in many cases. Out of every 100 new inventions in electro-metallurgy, 90 are impossible chemically or electrically. If I have ruthlessly cut out a possible or admitted an impossible process, I must ask pardon on account of the impossibility of trying all the processes myself, even experimentally, and must plead that I have been as skeptical as possible.

There are other directions in which electrolysis may play an important part. The improvement of the manufacture of white lead deserves the most careful attention. The Dutch process is unhealthy, costly and barbarous. The electrolytic manufacture of aniline dyes has received considerable attention. Dr. Goppelsroeder has done a good deal of work in this direction, and samples of silks dyed by electrolytically prepared colors were shown both in the Paris and Frankfort electrical exhibitions. The extraction of gold from sea water, which is said to contain minute quantities, need hardly be treated seriously. Even if it were possible, such a process would be of no use. All improved processes for obtaining precious metals merely enrich some at the expense of others, and reduce the value of the metals. Obtaining gold more easily would be no good to the community unless it became cheap enough to be used commercially.

## Adopted the Plans of the Berlin Iron Bridge Company.

The Edison Electric Illuminating Company, of Brooklyn, N. Y., have decided to build a new plant, and have adopted the plans of the Berlin Iron Bridge Company, of East Berlin, Conn. The building will be 74 feet wide by 100 feet long, with brick walls, the roof being the Berlin Company's well known patent anti-condensation corrugated iron construction. The floor space will be controlled by a traveling crane having a capacity of eight tons. The crane will also be furnished by the Berlin Company.

### The Trolley in Boston.

Boston, the acknowledged home of culture, spectacles and erudition, the hub of the Union, was the first of our large cities to adopt the trolley system of electric railways. To President H. M. Whitney, of the West End Street Railway Company, may be given the credit for the progressive and far-seeing spirit that prompted its adoption. This immense street railway corporation operates at present about 87 miles of double track, and 150 miles of single track, of which 81 miles is electric railway. Over 600 Thomson-Houston 15 horse-power motors are used in the propulsion of cars, and current is furnished by 62 Edison and Thomson-Houston generators of 80 and 100 horse-power each.

The conditions of urban and suburban rapid transit in Boston are most peculiar. In the city proper the streets are very narrow, crooked and crowded, the natural result of laying them out on the ancient cowpaths of the original settlement. In the newer suburbs the avenues and boulevards are wide, straight and comparatively level, allowing ample driveways on either side separated from the double electric tracks in the center by strips of carefully tended lawn. The maximum grade that Boston trolley cars are called upon to conquer is six per cent.

Along Tremont street, from Boylston street to Scollay Square, during the morning and evening hours of greatest travel, the observer will note two unbroken lines of street cars, most of them electric.

The illustration on this page shows the crowded condition of Boylston street near one of the main entrances to the Boston Common. The picture was drawn by Henry Sandham for *Frank Leslie's Weekly*, and the ELECTRICAL REVIEW is indebted to Mr. W. J. Arkell, the progressive publisher of that journal, for permission to reproduce it.

The crowded streets in the center of Boston render it necessary that high speeds be accomplished by the trolley cars in the more open districts. That the rapid transit service afforded to Boston and its suburbs by the West End Street Railway Company is eminently satisfactory is evidenced by the constant calls for the extension of the system. The response to these calls and the increasing popularity of the service are practical proof of the value of the trolley system of rapid transit to both the urban and suburban resident.

THE TROLLEY IN BOSTON.—SCENE AT THE CORNER OF BOYLSTON STREET AND PARK SQUARE.—DRAWN BY H. SANDHAM.

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The electric fan has enjoyed a successful season. It will soon succumb to its greatest competitor, Mr. J. Frost.

English royalty does not seem to be favorably disposed toward the electric light. It is said that the only portions of the royal yacht not fitted with electric lamps are the Queen's apartments.

It is not probable that the railway telegraphers will assist in the railroad strikes at Buffalo. The long distance telephone can be used in dispatching trains and other routine work usually performed by telegraph.

We are informed that the street railway company of Manchester, N. H., is to change its motive power from horses to electricity. The present horse railroad is a narrow gauge one, and we understand that the company contemplates making it over into a narrow gauge electric road. If this step is taken it will be regretted. It is bad engineering, prompted by a very short-sighted policy. Manchester is a growing city of nearly 50,000 inhabitants, and the best is not too good for her. The disadvantages of a narrow gauge electric road are too numerous to mention, but are well known to every constructing engineer. Give Manchester a standard gauge trolley road, and if the company hasn't enough money to do this properly now, let it wait until it has. A standard gauge must be had eventually, and if a narrow gauge road is equipped it will only be for a short time and then it will be torn up.

### *ANTI-TROLLEY HUMBUG.*

It is refreshing, after the deluge of sensational nonsense in the daily press about the trolley system, to read in the Pittsburgh *Dispatch*, under the above heading, such sensible remarks as these:

The factitious nature of the attempt to make the public believe in certain cities that the trolley is exceptionally deadly is revealed in a striking light by the last article in the New York *World* on that subject. This article contains a list of the accidents on the electric lines in Columbus for the year ended with the first of this month. It gives a list of 76 alleged accidents, and of that number there was exactly one caused by electric shock due to the peculiar nature of the trolley wire.

The other 75 were such as any method of transit faster than the horse cars is liable to; and some of them are common to the horse cars. For instance, when we find the list swelled by such examples as the following: "Unknown woman severely injured while stepping off car," we are impelled to ask whether it is the view of the opponents of the trolley that cars should be furnished which people will not have to step off from. It is the case that 14 of the 76 alleged casualties were those of persons injured while getting on or off the cars, a class of accidents only possible from the carelessness or weakness of the passengers. Almost the entire list of casualties thus produced to show the deadly nature of the trolley system proves nothing of the sort. It may prove that there is risk in providing rapid transit with greater speed than the snail-like pace of the horse cars; but, so far as the peculiar nature of the trolley is concerned, the search after accidents due from it yields surprisingly small returns.

The trolley should be abolished, when a practical substitute is found for it, on account of its incumbrance of the streets. But the evident attempt to manufacture calamity lists with which it can be charged proves its own falsity by the fact that about 98 per cent. of the casualties cited so far are not due to the trolley at all.

When one reads the absurd headlines continually set forth in the newspapers, such as "The fatal trolley," "Trolley's latest victim," "Another death by trolley," etc., and then reads on only to find it a case of mechanical accident, with which the electric current had nothing to do, one is inclined to ask why great metropolitan newspapers should be guilty of such debauchery of truth. As a rule, the newspaper of the period is nothing if not sensational. Newspapers, like other business enterprises, are conducted for profit, and profit lies in a heavy circulation and extensive advertisements. Sensational news attracts a mass of idle readers, and advertisers keep watchful of the fact. But when the press fills its columns with such arrant nonsense as it does about the trolley system, it not only does a wrong to a legitimate enterprise, but it makes a fool of itself.

Dignified and conscientious criticism is right and is welcome at all times, but with scarcely an exception the articles published on the trolley in the daily papers only make their claims to enlightenment and knowledge of true progress a subject for contemptuous cachinnation among the technical journals and those of the masses who observe and sift out the truth for themselves. It seems to us it is the duty of the managers of the daily press to put a stop to this wholesale prostitution of facts about the trolley system.

The Pittsburgh *Dispatch* is a good example of careful consideration and truthseeking. It has analyzed the wild statements made by another paper and found the truth, namely, that 98 per cent. of the casualties cited are not due to the trolley at all. They are due to a variety of causes incident to any system of rapid transit. Every one of these opponents of the trolley admits there is no objection to the storage battery system of propulsion. This is curious, seeing that the 98 per cent. of accidents would be just as liable with the one as with the other. The speed would be the same, the motors the same, the humming of the commutator the same. Mechanical accidents from carelessness and neglect of rules by passengers would be and are just as frequent. Hence, the greater part of the objections of such opponents is mere twaddle and betrays their insincerity.

The only valid objection then must be simply that which distinguishes the trolley from the storage system, and that is the existence in the former of the overhead wires, and of these only the bare trolley wires can be the object of fair attack, as the feed wires are heavily protected and have never caused an accident. The objectors would have the trolley wires prohibited if they could, blaming every accident on electricity and forgetting that mechanics has anything to do with the matter. But, as a matter of fact, mechanical construction has in many cases been faulty (owing to want of experience, of course), and the poor engineering has resulted in a broken and fallen trolley wire. The electrical feature is not to blame, the mechanical is; but the attack centers on the electrical factor all the same. It cannot hold itself up any more than the Brooklyn Bridge. The latter is but a gigantic span of wires, but its engineers built for durability on data previously experienced. Only now practically are our electric trolley engineers in the position to know just what does meet the requirements, and trolley wires are being put up which will stay up. The only remaining objection lies in the unsightliness of the overhead structure. With the pretty iron or steel poles now being used, and better designing of the whole aerial structure, the objection becomes trivial.

As to accidents from the electric shock, the trolley system surely has made a splendid record. Even its bitterest enemy cannot use the fingers of one hand in summing up such accidents to passengers, although several billion passengers have been carried unharmed by the many electric railways in the United States.

Newspaper writers should stop and think before making their absurd declarations. They should remember that capital is most sensitive about investment; that conservative business men have invested nearly $200,000,000 in electric railways in this country, and in so doing have vastly enhanced the public convenience. It is almost the universal experience that where one passenger rode behind horses, two passengers now use the motor cars. Is it not, then, absurd for the newspapers to contend that the trolley is dangerous to life and limb, and to try to give the impression that the trolley system is admittedly but a temporary makeshift? Is it not a little peculiar that all these assertions are in the nature of predictions and not the relation of facts realized? Do we hear continually of demands for the taking down of the trolley system in localities where its advantages have been tested?

Let the newspapers be a little more liberal to scientific attainments and accurate writing in selecting editors, and they will be not only guilty of less self-stultification, but will do less injustice to legitimate enterprises of large importance and great public convenience.

Alternating current motor work is taking precedence just now. Several inventors are "neck an' neck." Who will be first under the wire?

# CORRESPONDENCE.

## OUR BOSTON LETTER.

**The Stanley Electric Manufacturing Company**, of Pittsfield, Mass., has increased its capital stock from $50,000 to $100,000.

**The Canadian General Electric Company** has given notice of application to the Governor-in-Council for supplementary letters patent increasing the company's capital to $2,000,000.

**Mr. Cyrus O. Baker, Jr.**, of the firm of Messrs. Baker & Company, Newark, N. J., and Mr. Geo. L. Wiley, of the Standard Underground Cable Company, called at this office recently.

**The Palmer, Mass., Electric Light Company** held its annual meeting August 16, and elected officers for the ensuing year as follows: President, C. E. Fish; vice-president, C. L. Gardner, and treasurer, C. B. Fiske.

**Mr. F. W. Potter**, superintendent of the electric light and power station at Leominster, Mass., who met with a serious accident a few weeks ago, is rapidly recuperating, and will soon be able to attend personally to his regular duties.

**Mr. J. M. Orford**, until recently the superintendent of the Bridgeport Electric Light and Power Company, will commence business in Boston on or about September 1 in partnership with Mr. William Brophy, Jr., son of Captain Brophy.

**The Fitchburg Steam Engine Company** has recently shipped a 300 horse-power engine to the Windsor Locks, Conn., Steel Company and three engines aggregating 250 horse-power to the Hull, Mass., Electric Light and Power Company.

**The Washburn & Moen Manufacturing Company's** projected factory building, to be erected at Quinsigamond Village, near Worcester, Mass., is to be 256x120 feet in dimensions, two stories high. Work has commenced on the foundations.

**Dr. Louis Bell**, formerly of the Johns Hopkins University, and more recently the editor-in chief of the *Electrical World*, of New York, has been appointed engineer of the alternating lighting department of the General Electric Company.

**Capt. Wm. Brophy** has accepted the important position as inspecter for the Southern and Western districts of the Mutual Insurance companies on electric light station risks. No better selection could have been made by the insurance people.

**Mr. E. Wilbur Rice, Jr.**, has been promoted to the position of director and inspector of the experimental departments of the General Electric Company's factories at Lynn, Mass., Middletown, Conn., Cleveland, Ohio, Schenectady, N. Y., and Fort Wayne, Ind.

**The Edison Company's Western Massachusetts Supply House**, at Springfield, Mass., has been discontinued. Mr. E. Abbott Todd will retain his position as manager of the office, but for the combined interests of the Edison and Thomson-Houston electrical companies.

**The Northern Electrical Supply Company**, of Concord, N. H., was organized recently with the following officers, viz: President, T. L. Holtt; vice-president and treasurer, N. E. Martin; general manager, Wm. B. Ross; general agent, H. J. Lowell; superintendent, G. P. Warde.

**The Chapman Valve Manufacturing Company**, of Boston and Indian Orchard, Mass., reports its business as good and the demand for its various products unprecedently active and steadily increasing. The company's manufacturing facilities at Indian Orchard have been increased recently by the addition of two immense lathes for heavy work. The company now employs 275 men.

**Mr. G. H. Morrison**, whose office is at No. 6 Federal street, Boston, is an expert in making practical tests of steam, electrical and other power plants, and also indicates engines, weighs power, etc. Mr. Morrison's long, practical experience in these lines, as well as the importance to a successful operation of engines, and in fact all kinds of power by manufacturers, keeps him very busy filling orders. W. I. B.

Boston, August 20.

## OUR CHICAGO LETTER.

**Mr. Everett Morss**, of the Simplex Electrical Company, spent a few days in this city while on a pleasure trip to the West.

**Dr. John McKinlock** has been spending a few weeks with his family at Mackinac Island, and no doubt will return with renewed vigor for the winter's campaign.

**Frank McMaster**, who will be remembered by many of our readers from his connection with the Ball and Edison companies, is now traveling in the interest of George Cutter's specialties.

**The Many Friends** of P. F. Leach, vice-president of the Cushion Car Wheel Company, Indianapolis, Ind., will regret to learn of the death of his wife, Carrie B., which occurred Saturday, August 13.

**The Enterprise Electric Company** report business at their St. Louis branch opening up remarkably well. They are having a big call for National India Rubber wires, for which they are general Western agents.

**Romaine Mace**, the representative of the Interior Conduit and Insulation Company, has been spending a few days with the Central Electric Company consulting with them regarding the sales of the Interior Conduit Company's specialties. The Central Electric Company report flattering prospects for a heavy trade this fall on these now essential devices.

**A Recent Visit** to the new Athletic Building, on Michigan avenue, gave us an opportunity to thoroughly examine the excellent work which Mr. L. K. Comstock, the electrical engineer, whose office is in the Monadnock Building, has recently done in connection with the wiring of the building, and the use throughout of Interior conduit tube. Mr. Mace, the expert of the Interior Conduit and Insulation Company, on examining it, stated that it was as perfect and complete a piece of work as he had ever seen, and reflects great credit upon Mr. Comstock's able corps of assistants. The conduit for this building was furnished by the Central Electric Company. M. J. B.

Chicago, August 20.

## Fire Alarm Telegraph Apparatus.

TO THE EDITOR OF ELECTRICAL REVIEW:

Assuming that it will be a matter of public interest, of which your paper will naturally take notice, I write to state the exact facts regarding the recent decision of Judge Colt in the United States Circuit Court in the cases of the Municipal Signal Company *vs.* the Gamewell Fire Alarm Telegraph Company.

These cases were argued in December, 1891, the testimony having been taken before an examiner and printed. The apparatus which was the subject of contention, and which we claimed that the Gamewell Company was infringing, consisted in the combination of a register and time stamp by which a signal is recorded and the time of its reception stamped upon a paper tape at the same moment, and a second which gave an audible alarm for some signals and received silently other signals sent from the same sub-station.

In both of these cases the court decides that we are the owners of the patents, and that we are the only concern which has a right to make and sell or authorize others to use apparatus made under them.

These features are essential in a modern police signal system, and we are, of course, much pleased to have the court confirm our contention and give us a clear title to our property. Very truly yours,

A. H. CHAPMAN, General Manager.

Boston, August 16, 1892.

## PERSONAL.

Mr. J. J. Nate, of the Chicago Telephone Company, has been visiting in the East and favored the REVIEW with a call Monday of this week.

A dispatch from Champaign, Ill., says that Prof. Daniel W. Shea, of Portsmouth, N. H., has been elected assistant professor of physics and electrical engineering by the trustees of the University of Illinois.

Mr. Robert M. Huston has retired from the managership of the Eastern agency of the Heine Safety Boiler Company. Mr. John MacCormack has been appointed agent and sole Eastern representative of the company, with offices at 45 Broadway, New York.

Mr. Herbert Laws Webb, formerly with the Metropolitan Telephone and Telegraph Company, of this city, and a well known electrical writer, sailed for Europe on Wednesday of last week. He will spend some time in England, returning to New York in October.

Capt. W. L. Candee, of the Twenty-third regiment of this State, commanded a battalion at Buffalo, N. Y., where the militia had been called to quell the strikers. The captain was dining at his club Tuesday evening of last week when orders came, and in two hours he was *en route* with his battalion for the scene of the strike.

Mr. C. S. Rusling, an able young electrical engineer, formerly with the Thomson-Houston Company, at Kansas City, has been placed in charge of the railway department of the General Electric Company's central district with headquarters at Cincinnati. Mr. Alex. H. Lewis, formerly in charge of this department, has been transferred to the railway department of the New York office under Mr. Wm. J. Clark.

## OUR LONDON LETTER.

In the streets and thoroughfares of London private installations are rapidly multiplying. Many small establishments now display the coveted brilliancy that a few weeks ago was only to be seen in the large warerooms of wealthy merchants. And electricity, which in the writer's boyhood was an interesting but unpractical subject of study for the scientific, and more recently for awhile a luxury of the rich, accessible only to them, has now come within reach of all. This change is the immediate result of the general reduction of the charges for installation and electric service, while such reduction of charges is rendered possible only by the increased demand for supply. Of course, no reasonable person could expect identical or uniform charges to be fixed at once. The several companies carry on their works under very various circumstances. But, allowing for these circumstances, there is really little diversity, and nowhere could the most captious critic point to an overcharge. During the last month the following reductions were announced: The New Islington Supply Company offers current at the uniform price of 5*d.* per Board of Trade unit, both for day and night load. The Westminster Electric Corporation will supply current for motor purposes during the day only at a charge of 5*d.* per unit, but for day and night service the charge will be 7*d.* The St. Pancras Vestry are charging 3*d.* per unit for current for the day load and 6*d.* per unit for the night load. The St. James and Pall Mall Electric Light Company makes a uniform charge of 7*d.* per unit, whether used by day or night. The Metropolitan Electric Supply Company charges 7½*d.* per unit for day or night. The House to House Electric Supply Company charges 8*d.* per unit for day, but gives no quotation for the night supply. The City of London Electric Lighting Company, the Kensington and Knightsbridge Electric Lighting Company, the Chelsea Electric Supply Company and the Crystal Palace District Electric Supply Company charge a uniform rate of 8*d.* per Board of Trade unit, whether consumed by day or night.

Another notable sign of the progress of electricity is its admittance into the University of Oxford. The lighting of this venerable establishment, and others of a similar class, has been hitherto of a very primitive character, consisting principally of oil lamps. Even gas has been allowed to enter only under severe restrictions. The Oxford Electric Company, however, since their recent inauguration in the city, have done excellent work, and last week happily completed an installation in the dining room of Magdalen College. The president and all the collegiate authorities were present, and declared themselves highly satisfied. Brasenose and Hertford Colleges are also being fitted with electric light throughout, and the work will be finished in both places in a few days. The Oxford Company are laying down a considerably large number of underground mains through different streets to cope with the increasing demands made upon them, and hope that before term begins all the principal colleges and halls will have adopted the new system of lighting.

Into another distinguished seat of learning—"less, but not little"—electric light has won its way. At a meeting of the Rugby local board last week an application was made on behalf of the governing body of Rugby school for permission to lay an installation of the electric plant to light the whole of the school premises and the boarding houses. The application was granted. Several fires have occurred at the school in consequence of gas, and the decision to adopt electricity is said to be mainly due to this and also to economic causes.

At the evening service on Sunday week, the Catholic Cathedral at Newcastle-on-Tyne was lighted for the first time by electric light. "To the best of our knowledge" says *Electricity*, "this is the first example of a Catholic church illuminated after the new fashion. It is a case of the oldest church taking advantage of the newest scientific means." Our clever scientific contemporary is mistaken with regard to facts. In England, Ireland, France, and even in Rome, there are Catholic churches so lighted; nor is this to a Catholic any matter of surprise. Electricity is used, not for ritual or ceremonial purposes, but solely when artificial light is necessary; and then, as being the best, it is adopted wherever it is available. Some months ago, as soon as it became possible by the installation at Tivoli, the Vatican was fitted with electricity throughout by order of the head of the Catholic church, Pope Leo XIII. JOSEPH FFRENCH.

London, August 13.

## LETTERS FROM A LABORATORY.—IX.

BY JULIAN A. MOSES.

If you know, while making an instrument, some parts being of iron, that it is liable to be exposed to fumes of acids, salt air or moisture, you will be wise if you take this ounce of prevention.

If the iron or steel parts be such that they will not be affected by heat, they may be prepared as follows: Heat the iron object to a temperature just below that of redness and plunge it into a vessel containing linseed oil. Immediately withdraw it, permitting the linseed oil to burn off in the air. When this has been done, you will find your iron covered with a dead black coating which is hard and durable, and acts as a very satisfactory protection against rust.

It was a bold statement that the late Phineas T. Barnum made when he said that "The public likes to be humbugged." His wonderful success showed how accurate was his judgment of men. Every great man has his imitators; and Barnum was no exception. The public has changed but very little since that time, and the conditions being the same there are still new frauds and devices to attract the public and its dollars. It still desiring to be fooled, swallows any bait, hook and all, provided it be tempting.

Those frauds that pay must be universal in their adaptability, and I am sorry to say that electricity has been put to so unworthy a use, to fool a generous public.

We have our lightning rod frauds, electric girls, electric bells, electric and magnetic rings and many others too numerous to mention.

I have had occasion to examine several of them and have found them to be, on the surface, so plainly frauds that I have wondered why it is that a so-called intelligent public will permit itself to be insulted; for it is an insult to offer such bait to a person with an education.

The "electric belt" generally consists of an oil cloth tube with a few pieces of copper and zinc kept moist by some dilute acid. The advertisement tells the prospective purchaser, in highly colored and glowing terms, of the wonderful cures caused by electricity. If you are skeptical the dealer lets you taste the two ends, and you are expected to be convinced of its "wonderful curative powers." As a matter of fact, you can get just as much taste from a ten cent piece and a penny on either side of the tongue. You are now informed as to the minute particulars, and are directed to wear the oil cloth belt next to your skin. The "gentle current of electricity" has done its work, for an eruption is seen. This, however, is due to the contact of the water and air-proof oil cloth with the skin. Notwithstanding which, if you are gifted with an abundance of faith, you are cured of whatever disease you thought you had.

Your attention is always called to that "gentle current of electricity flowing around the affected parts." The company has numerous testimonials from imaginary persons, thanking the inventor for saving their lives. These poor sufferers have invariably given up all hope, when some unaccountable circumstance tells them that they should try "Dr. ——'s Electric Belt." Of course, it cures them, and they live to bless the inventor.

These frauds have done a great deal to prejudice the public mind against the more general use of electricity, and it is to a certain extent due to the way in which our newspapers aid the promoters by inserting their vivid and descriptive advertisements. It is not expected that this can be prevented, but let us awaken the public to the fact that in these cases, "All is not gold that glitters," and that even the most corroborated of these so-called testimonials published by these quacks must be taken *cum grano salis*. It is a difficult task to attempt, but we owe it to those who are hurt in their business by these misleading statements.

The newspapers of to-day are only too glad to publish interesting exposés; so let us unite in holding up to the ever watchful eye of the press, those frauds that we deem hurtful to the electrical fraternity and prejudicial to the public.

## TELEPHONE TALK AND COMMENT.

The telephone companies of this country are now casting about for a satisfactory method of distribution from the terminals of cables, both overhead and underground. One of the principal requirements in the overhead distribution is a satisfactory twin wire to meet the demands of metallic circuit work. While all of our principal manufacturers are now turning out a satisfactory insulated wire twisted in pairs, yet this method hardly commends itself to telephonists as being an ultimate solution of the case.

The Metropolitan Telephone and Telegraph Company has recently established a successful branch office at the corner of Fifty-eighth street and Columbus avenue. The naming of this office, in pursuance of the policy of the company to always have the locality indicated by the name, was attended with some difficulty. If it should be called "Fifty-eighth Street" it would likely be misunderstood for "Thirty eighth Street," if it were called "Fifty-ninth Street" it might be confounded with "Seventy-ninth Street." So it was called "Columbus," which seems to meet the requirements of transmission, and may also be considered a recognition of the Columbus era.

Mr. D. I. Carson, the head of the Southern Bell Telephone Company, is following the wise policy which led to the recent convention of his superintendents and exchange managers by a vigorous campaign of reconstruction throughout his entire territory, which embraces the States of Alabama, Florida, Georgia, South and North Carolina and Virginia.

President Morris F. Tyler and his able aid, Superintendent E. B. Baker, of the Southern New England Telephone Company, are rapidly completing the work of converting their entire system to a metallic circuit basis. This work when completed will place the company in an enviable position with reference to local and long distance business, and, judging from our experience with the service in that territory, the subscribers there have reason to be satisfied with it.

The Missouri and Kansas Telephone Company is making its stockholders happy by sending out dividend checks. This company is succeeding finely, and President Mulvane and his experienced assistants, Messrs. Wiley W. Smith and Chas. W. McDaniel, are to be congratulated.

In the matter of progressive telephone work the Pacific coast is not behind the rest of the country. General Manager John I. Sabin keeps himself fully informed on the latest developments in the matter of metallic circuits, multiple switchboards and bridging bells. His entire toll line system has been equipped with bridging bells and talking is easy between the furthermost points of his territory. With his underground construction, new central offices and progressive management, it would seem that Mr. Sabin would be able to hold his own in the telephonic field against all comers.

It is said to be an unwritten law of the American Bell Telephone Company that none of its officers shall speculate in its own stock. Whether this be true or not, it is a fact that the business of the company is conducted with reference to the rights of investors, and the sound, conservative policy that has been pursued by this organization might well be copied by other large corporate interests.

### A New Electric Road.

Messrs. Pepper & Register, electrical engineers, of Philadelphia, have secured the contract to build the Easton, South Easton and Phillipsburg Electric Railway, now consolidated and called the Easton Transit Company, work on which will begin not later than September 10 and to be completed by Thanksgiving Day. The road will be a modern one in every way.

## New System of Electrical Distribution.

A NOVEL DEVICE ADAPTED FOR ALTERNATING AND DIRECT CURRENTS.

In a patent recently issued to Mr. Chas. Selden, of Baltimore, Md., a novel system of electrical distribution is described, in which the translating devices, such as lamps, are placed in the bridge wire of a Wheatstone bridge connected in the main circuit. The invention is applicable both to direct and alternating currents. The simplest form of the system is illustrated in Fig. 1 of the accompanying diagrams; X,Y represents the bridge wire of a Wheatstone bridge, *a*, *b*, *c*, *d*, interposed in the main circuit of a generator.

The resistances in the sides of the bridge are adjusted to create any desired difference of potential at the terminals of the bridge wire and thus supply the lamps with current. By suitably adjusting the resistances this difference of potential may be varied within wide limits, irrespective of the voltage of the line current, and thus in a circuit of high potential a current of low potential is available without the use of the usual inductive transforming devices. For example, suppose that the main current has a potential of 2,000 volts and it is desired to

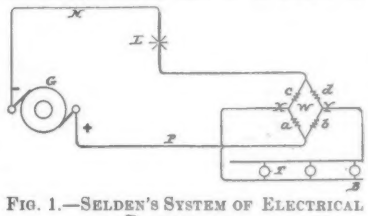


FIG. 1.—SELDEN'S SYSTEM OF ELECTRICAL DISTRIBUTION.

utilize in a branch circuit a current of 100 volts, it is evident that, by properly proportioning the resistances in the sides of the bridge, a difference of potential may be established between the points X and Y of 100 volts, and by interposing lamps between these points a low tension current will be supplied. In such cases as utilize a line current having a wide variation of potential, the current may be made steady in the bridge branch by making the resistance of sides of the bridge comparatively high, but as this involves a waste of current, a preferable scheme is to use a compound bridge, as shown in Fig. 2. In this case the difference of potential between the points X and Y is set at the proper point by proper adjustment of low resistances *a*, *b*, *c*, *d*, and in the bridge wire is formed another bridge having in the sides high resistances $a^1$, $b^1$, and thus, although considerable variations of potential may exist at the points X and Y, the high resistances $a^1$ and $b^1$ in the two bridges compensate for these variations without in any way interfering with the current of the main circuit. As an auxiliary contrivance for steadying the currents in the lamps T of the bridge wire, a magnet $M^4$, the armature of which is adapted to form a sliding contact with the resistances $a^1$ and $b^1$, may be used, which in being shifted under any fluctuation of current preserves the uniformity of difference of potential between the points $X^1$ and $Y^1$ of the secondary bridge.

### Interesting Telephone Incidents.

A striking and at the same time extremely interesting illustration of the telephone as a sound transmitter occurred yesterday afternoon at the office of the *Evening Telegraph*. The paper receives its New York news by direct long-distance telephone. Shortly after 2 o'clock there was a noisy clanging of fire gongs in front of the office, as the engines tore up the street toward Cherry, whence an alarm of fire had been turned in.

"Is that fire in your building?" queried the New York correspondent of the 'phone operator at the Philadelphia end, "No," was the response from the astonished operator. "It is up the street somewhere. Did you hear the bells?" "Yes," replied New York. "I heard them very distinctly."

This is not the first time that the same striking incident has occurred in the same office on the same wire. The previous experience was reversed, the Philadelphia operator, during the great naval celebration in New York city, having plainly heard the tattoo of the drums as they marched in the procession.—*Philadelphia Record.*

## The Madison Square Garden Tower Electric Railway.

Many visitors to New York during the past year have availed themselves of the opportunity to view the city from the famous Madison Square Garden tower.

Visitors are accommodated to the second loggia by a spacious Otis elevator; from here an easy ascent is made to the fifth loggia, where, if one is fortunate enough to secure admission to the circular veranda, he will see a novel electric railway.

The purpose of this railway was conceived by Mr. Stanford White, of the well-known firm of McKim, Mead & White, who are architects of the garden, to carry the electric projector built by the General Electric Company around the tower.

The projector consists of a mortar shaped band mounted on a standard built of sheet iron and insulated from the base by a large wooden gasket.

To supply current to the lamp, heavy mains are run from the dynamo room to the tower; one wire of the same polarity as the neutral of the street service is connected directly to the rails, the other, after being intercepted at the second loggia by a rheostat, is connected to a strip of copper, which is fastened to the inner circumference of a large insulated support, placed between the rails. The construction of this support is such that quite a suitable promenade is made around the tower.

Current is taken from this conductor by means of a heavy brush fastened to an insulating arm, and is kept in firm contact on every portion of the circuit.

The arrangement of the carbons, and mechanism for regulating them, is of the finest and most sensitive nature. On the top of the lamp just above the carbons is placed a box containing the motor and relay, the latter capable of reversing the motor to a sensitiveness of a fraction of a volt.

The mechanical operation of the carbons is as follows: A right and left threaded shaft, to which the carbons are connected by adjustable nuts, the difference in the pitch of the two screws is calculated to be proportional to the difference of consumption of the carbon and a tangent screw which operates the shaft by means of the small motor.

The electrical operation is effected by the use of a relay which is a shunt from the two carbons, so that when the arc becomes greater its resistance, as compared with the relay, is greater. The latter is allowed to act and switches the motor so as to feed the carbons together and, consequently, reduce

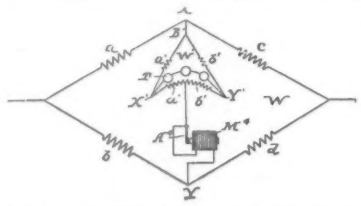


FIG. 2.—SELDEN'S SYSTEM OF ELECTRICAL DISTRIBUTION.

the resistance of the arc till they rest at a point of equilibrium which is regulated according to the size and density of the carbons and the amount of current given the lamp. The motor is differentially wound so as to avoid sparking of the relay armature in changing the contacts.

In the rear of the projector is placed a reflector of the Mangin type; it is said to be the most perfect and strongest in the country, having been especially imported for this installation. In its center is fastened a crystal prism which transfers the image of the carbon points to a little ground glass plate at the side of the projector, similar to the inverted image of a camera focusing glass. This arrangement is indispensable to the operator, who can at all times view his arc without the blinding rays of the direct light. Another good feature consists in the glass being a gauge as regards the focus of the reflector and by its aid and the adjusting screw at the base of the lamp, a perfect center is at all times maintained. In the Edison projector a convenient alternative is taken from the general construction of focusing lamps of this kind; instead of adjusting the carbons to the reflector it is *vice versa*, and a beam of varying intensities and magnitudes may be attained by the use of the hand wheel at the back of the lamp.

In setting the carbons great care is taken to keep them in perfect alignment in one direction and to place the positive carbon a little in advance of the negative in the other, so that the crater on the former may in itself act as a reflector to throw the otherwise diverging rays directly into the larger reflector. To aid this and to concentrate the heat at the arc a hemispherical crucible is fastened to the carbon frame and is lined with a refractory material.

To supply current to the motor for propelling the car, and also the smaller motor which feeds the carbons, both of which are wound for a higher potential than the lamp requires, a special trolley wire is suspended from the iron railing on the side by porcelain insulators. Bearing on the lower surface of this wire is a brush which is connected down the trolley to the two motors, respectively.

In order to make the plant a success a first-class electric motor was an indispensable requisite, and consequently one of the perfected Crocker-Wheeler motors was used to propel the car, which is also furnished with a Crocker-Wheeler reversible regulator, so as to place the whole in perfect control of the operator.

An insulated tangent screw is connected to the motor shaft, thus reducing the speed to a maximum of 15 revolutions of the car wheels per minute, it being thought that a speed greater than that would be dangerous in case of any carelessness of the operator, who might for a moment doubt the centrifugal force in nature which could dislodge him from that dizzy height. But even at that speed and the projection of the light left on a plane, the wide circle of the far-reaching beam would sweep the surrounding country like a flying spectre.

The projector carriage was especially designed for the purpose by Mr. Van Vleck, of the Edison Electric Illuminating Company, of New York, and his assistant, Mr. Wm. Erickson.

At a pressure of about 45 volts, the lamp will operate with the best results with 50 amperes of current to produce a light which will enable one to plainly distinguish objects at a distance of over three miles. Such statements will show the whole installation to be rather an economical advertisement, and doubtless will be taken up by many architects in designing pleasure resorts of this kind.

## WORLD'S FAIR NOTES.

The New York Central Railroad, in its exhibit at the World's Fair, will strikingly illustrate the wonderful improvements that have been made in railway transportation by showing a magnificent, complete vestibuled train and along side of it a reproduction of the first train of cars used in this country, the cars of which resembled old-fashioned stage coaches.

The California Capitol will be represented in miniature at the World's Fair by an exhibition of pickles. The women of Fresno county will distribute 2,500 pounds of raisins in souvenir boxes. A playing fountain of wine will form a feature of the viticultural display. A rose tree 24 inches in circumference will be one of California's exhibits. The woman having the wild flower display in charge will have as many as possible growing and blooming around the California building, and school children throughout the State have been enlisted in making collections of native flora.

The Baltimore and Ohio Railway Company will make a historical exhibit at the World's Fair which will be of absorbing interest to all railroad men. Major J. B. Pangborn has charge of its preparation. The Baltimore and Ohio claims to be the oldest railroad in the world, its two or three predecessors having been mere tramways for transporting coal, stone or ore. The actual construction of the road began on July 4, 1828, and its first section was in operation six months before the Liverpool and Manchester road, the first railroad, in the present sense of the word, in Europe. The Baltimore and Ohio claims also to be the only one of the pioneer roads which has retained its original name and has remained under a continuous succession of management.

A separate building at the World's Fair for the shoe and leather industry exhibit is now an assured fact, as the required $100,000 has all been raised. Leather dealers and manufacturers in all parts of the country have contributed to the fund. The building will be one of the handsomest on the grounds, having been designed by Sandier, an eminent French architect, now connected with the Fair. It will measure 150 by 575 feet, and will contain everything in the way of leather and the products of leather exhibited at the Fair. The most improved machinery used in leather manufacture will be shown, as also the manufacturing processes. The visitor may watch this from the raw hide to a finished shoe or dainty slipper. It is likely, too, that rubber goods and their manufacture will be shown in this building. Altogether the exhibit will be far larger and more complete than anything of the sort ever before attempted.

# Rational and Empirical Formulæ Showing the Relation between the Magneto-Motive Force ($H$) and the Resulting Magnetization ($B$).

READ AT THE GENERAL MEETING OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, CHICAGO, ILL., JUNE 6, 1892, BY CHARLES E. EMERY, PH. D.

## Part I.

Sec. 1. It is proposed to present in Part I of this paper the results of investigations designed to ascertain the general principles underlying the observed relations of the electric exciting or magneto-motive force ($H$) to the resulting magnetization ($B$), with a view of developing a rational equation therefor. It is believed that rational functions based on physical facts have been found ample to account for the peculiar shape of the $H$-$B$ curves of magnetization. The theory that magnetization is the circulation of an ether is examined by the law of the flow of fluids, with the gratifying result that a rational fluid function has been developed which corresponds very well with the observed curves of magnetization, and which, moreover, shows decidedly a phenomenon equivalent to that of magnetic saturation. The observed results indicate a more intense action during the earlier stages of magnetization than is provided by the fluid function, but the discussion shows that the theory of molecular magnets appears quite sufficient to account for such intensified action. Following the discussion on this subject there are presented in "Part II," Sec. 23, empirical formulæ for practical use, corresponding satisfactorily with typical $H$-$B$ curves derived from experiments, and in the "Conclusion," Sec. 36, a general formulæ is derived, embodying the fluid function first discussed and a linear function, which together satisfactorily represent on a rational basis the observed conditions throughout the entire range of observation, including Ewing's experiments with very high magnetizations.

Sec. 2. The human mind must found its impressions of unseen phenomena on analogy, so it is natural to suppose that all "action at a distance" is due to the motion of something extending through that distance. The rational discussion is based on a theory which has heretofore been proposed in substance, though generally with hesitation, shown by the fact that other plausible theories were advanced in the same connection. It will be considered that the magnetic field results from the circulation along definite lines of an ethereal atmosphere of such extreme tenuity that it moves readily through all bodies, fluid or solid, of which our senses are cognizant, though, like other fluids, capable of being moved and directed by other forces and of being concentrated in certain paths by particular materials.

Sec. 3. If this theory be true, the etheric fluid should respond to the same laws as govern the flow of other fluids, air and water for instance, and we will first examine the formulæ relating to fluids tangible directly to our senses, and see if the flow of a fluid of such extreme tenuity, that we cannot feel, see or hear it, but only judge of its presence and its circulation by the results produced, will show in such formulæ a substantial agreement with the observed results. Starting with the well-known formula derived from the law of falling bodies,

(1) $$v = \sqrt{2\,g\,h}$$

in which, evidently, $v$ equals the velocity, $g$ the acceleratrix of gravity, and $h$ the head or vertical height of column, we may derive at once the formula for the flow of fluid in a pipe or constrained space as follows:

Sec. 4. If $a$ = the area of the channel or pipe considered, $D$ = the specific weight, or weight of a cubic unit of the fluid considered, and $G_1$ = the weight of fluid passing a given point in a unit of time, we have

(2) $$G_1 = a\,v\,D$$

By combination with Eq. 1 we have

(3) $$G_1 = a\,D\,\sqrt{2\,g\,h}$$

If $p_0$ equals the pressure per superficial unit, due to the head $h$, evidently

(4) $$p_0 = D\,h$$

(5) $h = \frac{p_0}{D}$, which, substituted in Eq. 3, gives

(6) $$G_1 = a\,\sqrt{2\,g\,D\,p_0}$$

which is the ordinary form of the equation showing the force required to overcome the inertia of the mass and give the same a velocity necessary to produce the flow $G_1$ in a circuit without resistance.

Sec. 5. There are various external conditions which also affect the flow, depending upon the apparatus and materials employed, such as the particular shape of the nozzle through which the fluid is to flow and the "hydraulic mean depth" and the roughness of the surfaces of a pipe or channel. These differences are usually provided for by considering either that it requires a certain head $h_1$ or pressures $p_1$ to overcome such resistances, so the total pressure required will be $p_0 + p_1$. Generally in practice the force $p_0$ required to put the mass in motion is so small that it may be neglected in comparison with $p_1$ required to overcome resistances. It is found also that the flow does not vary directly as the pressure $p_1$, so a function of $p_1$, or a function of the velocity easily reduced to a function of $p_1$, is generally employed to develop a variable coefficient of $p_1$, which will provide for the varying external conditions. On this basis $p_1\,(f\,p_1)$ (read $p_1$ multiplied by function of $p_1$) is to be substituted for $p_0$ in Eq. 6.

Sec. 6. With an elastic fluid the density $D$ practically varies with the total pressure, so if we let $D_1$ represent the weight of a cubic unit at unit pressure, the weight due to any other pressure $p_2$ will be $p_2 D_1$, which is to be substituted for $D$ in Eq. 6. Thus we see that for an elastic fluid the flow depends upon two variables, viz., the density and the pressure required to overcome the resistances. Many formulæ have been developed to show the observed relations, some of which are very imperfect, except when applied to the observations upon which they were based, while others fairly express the true relation. Many years ago Napier advanced the theory, based on experiments with the discharge of steam through orifices, that the flow increased rapidly with the difference of pressure at the two ends of the orifice until the difference of pressure somewhat exceeded one-half the total pressure, when the flow abruptly became constant for all increased differences of pressure. During the construction of the plant of the New York Steam Company, the writer had a series of experiments carefully made on the subject, and a smooth curve was obtained with limiting values such as indicated by Napier. In other words, the flow increased much more rapidly than the difference in pressure at first, and slower afterward, as if approaching a limiting constant value.

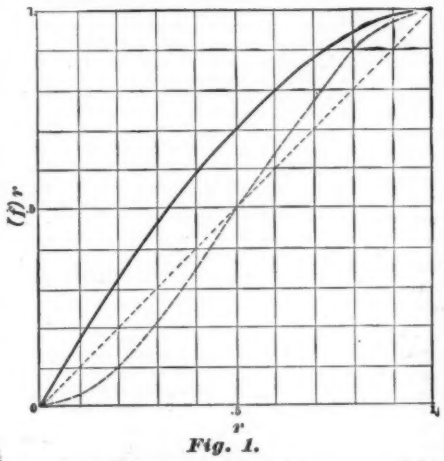



*Fig. 1.*

Sec. 7. The writer has obtained a rational function expressing these relations in the following manner, which has not been heretofore published: If $p$ be the total pressure, it is evidently equal to $p_1 + p_2$ above, viz., to the sum of the pressures required to overcome resistance and available to increase the density. In any given case $p$ is constant, and $p_1$ and $p_2$ form different proportions of $p$. If, therefore, we consider that the portion $p_1$, required to overcome resistances, $= r\,p$, the remaining portion $p_2$, to which the density is proportioned, will equal $(1 - r)\,p$. The expression $p_1\,(f\,p_1)$ (Sec. 5) may be replaced by $r\,(f\,p)\,p$, in which the coefficient of $p$ has two factors, $r$ and $(f\,p)$. So, also, the density (Sec. 6) $p_2$ $D_1 = D_1\,(1 - r)\,p$. The product of the two expressions is then $D_1\,r\,(1 - r)\,(f\,p)$ $p^2$. All the considerations above expressed may be embodied in an equation and the difficulties some have encountered overcome by considering that Eq. 6, relating to the flow of an incompressible fluid, indicates the general form of a *differential* equation of the flow of an elastic fluid, which will show the momentary rate of flow of its elementary masses. Calling $G$ the weight of elastic fluid passing a given point in a given time, and substituting the same for $G_1$ and the expression above for $D\,p_0$ in Eq. 6, squaring the result temporarily and expressing it as a differential, we have for the differential equation of the square of the flow of an elastic fluid the following:

(7) $$d\,G_2 = 2\,a^2\,g\,D_1\,p^2\,(f\,p)\,(1 - r)\,r\,d\,r$$

Integrating and taking the root we have

(8) $$G = \left(2\,a^2\,g\,D_1\left(\frac{r^2}{2} - \frac{r^3}{3}\right)(f\,p)\,p^2_{max}\right)^{\frac{1}{2}}$$

Making $\left(\frac{2\,a^2\,g\,D_1}{6}\right)^{\frac{1}{2}} = A$, we have

(9) $$G = A\,(3\,r^2 - 2\,r^3)^{\frac{1}{2}}\,(f\,p)\,p_{max}.$$

In applying this equation to etheric magnetic flow, it should be born in mind that Ewing shows that the magnetization $B$ is made up of two parts, one due to what we call the concentrating influence of the iron, which in connection with a somewhat different course of reasoning he calls $I$, and to which Eq. 9 can only be made to apply, and the other directly proportioned to $H$, due to what we describe herein as the flow of lines through the space occupied by the iron as though no iron were present. For etheric magnetic flow, then, the above equation takes the form

(10) $$I = A\,(3\,r^2 - 2\,r^3)^{\frac{1}{2}}\,(f\,H)\,H_s$$

in which $H_s$ = the value of $H$ when the iron is saturated. We have also

(10$a$) $$B = (H + I) = H + A\,(3\,r^2 - 2\,r^3)^{\frac{1}{2}}\,(f\,H)\,H_s$$

in which the function $(3\,r_2 - 2\,r_3)^{\frac{1}{2}}$ develops a factor of the variable coefficient of $H_s$, depending upon the law of the flow of fluids, and all influences on the value of $I$, due to external causes, are provided for by the other factor, $A\,(f\,H)$.

Sec. 8. In the expression $\sqrt{3\,r^2 - 2r^3}$, if $r = 0$ so that no part of the pressure is expended to produce motion, the whole equation reduces to 0 and there is no flow. If $r = 1$ the expression containing $r$ reduces to unity. The ordinates of the fluid function are shown proportionally in Fig. 1. A direct linear function is shown by the diagonal. The modification due to $3\,r^2 - 2\,r^3$ is represented by the reversed curve in dotted lines crossing the diagonal at the center of the figure, and the complete function, including the square root of the above, is shown by the heavy line curve. The latter is in general similar to a curve showing the relation of the exciting force $H$ to Ewing's intensity of magnetization $I$, and also resembles an $H$-$B$ curve of magnetization, with a less intense initial action, which is yet to be provided for by substituting in Eq. 10$a$ the value of $(f\,H)$. In Part II a number of $H$-$B$ curves are shown, which may be examined for comparison.

Sec. 9. If we adopt the theory of etheric flow, we must conceive that the magnetization expressed at present as a definite number of magnetic lines is represented by the flow of a definite weight of etheric fluid. Recalling the signification of $r$ and $1 - r$ in connection with Eq. 7, it will be seen that the fluid function simply shows that when $r$ is small, but little of the exciting force is expended in forcing forward the etheric fluid and the larger portion of such force is utilized in increasing the density of the etheric fluid circulated, so that the weight circulated, and therefore utilized, is large compared to the exciting force expended to produce circulation, a higher percentage of the total exciting force is utilized and a higher efficiency of transmission obtained. When, however, the flow in a given area is increased, a larger proportion of the exciting force is required to produce the circulation and a smaller quantity available to increase the density, so the weight moved approaches a limiting or constant value which evidently will be reached when the volume is infinite and the density zero, a condition typified when $r = 1$ in Eq. 0 and Fig. 1, and by the magnetic condition that the permeability $\mu$ and the induction $I$, due to iron, each reach a maximum. *We, therefore, call especial attention to the fact that the simple laws relating to the flow of tangible fluids show a limiting condition analogous to that of magnetic saturation.* If, as in Sec. 44, the value of $(f\,H)$ in Eq. 10 be derived by modifying the exponent of the fluid function, evidently at saturation, from Eq. 10. $I_s = AH_s$ = also $K$ Sec. 42, and from Eq. 10$a$, $B_s = (A+1)\,H_s$.

Sec. 10. The fluid function not only has an important bearing on the $H$-$B$ curve of magnetization, as the shape of the curve would indicate, but may also, it is thought, be applied to correct on a rational basis the laws of the magnetic circuit. Recurring to formula 10 and to curves shown in Fig. 1, it is evident that, for a circuit of low resistance, very small values of $r$ apply. When there are air gaps in the circuit increasing the resistance there should by analogy be a high pressure developed in the portion of the iron excited and a great fall of pressure at the gaps producing the principal resistance. This would require higher values of $r$, the same as if more etheric fluid were to be forced through a circuit of low resistance, but the actual flow or flux through the circuit containing the resistance would be less than in the other case, and this would of itself cause the resistance in the excited portion of the circuit to be less and permit a higher pressure there than if the same weight of etheric fluid (number of magnetic lines) were flowing at the time as would flow with the same exciting force in a circuit of low resistance. These considerations show that the laws of etheric flow in a magnetic circuit of low resistance need modification when applied to a circuit provided with air gaps. The fluid function above developed should aid in making the necessary corrections. The whole subject is so broad that this branch cannot at this time be further considered.

Sec. 11. It is apparent that the changes of the coefficient of $H$, due to the fluid function alone, are insufficient to account for the extreme values and abrupt changes in $H$-$B$ curves of magnetization. We, however, find that not only do the laws relating to the flow of elastic fluids impose no condition antagonistic to the adoption of the theory of etheric flow, but, on the other hand, the elements of the fluid function vary in the right direction and show a limiting value akin to magnetic saturation. They therefore aid in the development of the $H$-$B$ curve, and in addition indicate means whereby one general law may be extended from the excitation of an iron ring of low magnetic resistance to magnetic circuits of the highest resistance.

Sec. 12. As mentioned above, the shape of nozzles, the hydraulic mean depth and the roughness of pipes and natural channels modify the flow of tangible fluids, as represented by $(f\,p)$ in Eq. 9, so in investigating etheric flow the conditions of the problem, other than those imposed by the fluid function, must be based on external conditions due to the environment represented by $(f\,H)$ in Eq. 10, and one of the elements of the $H$-$B$ curve of magnetization be derived, not from the laws relating to the flow of fluids, but from the peculiarities of the material used for the concentration and transmission of the etheric current (magnetic lines of force), iron for instance, as modified by the reactions between the flowing current and the molecules of the iron.

Sec. 13. At this point special attention is directed to Fig. 2, which is a reproduction of one of Kirkaldy's sheets, showing the decrements of length, under a gradually increasing thrusting stress, of ten Fagersta steel plates, each 100 inches long, part of which were annealed. The general similarity of appearance between the several curves and the typical $H$-$B$ curve, Fig 3, will be at once apparent. Curves showing the results arising from the mechanical compression of soft steel, rather than of iron, have been selected, simply from the fact that few compression curves are accessible in the publications. Curves showing increments of extension are more familiar and very much resemble those given, but the compression curves are better adapted for the present purpose, as will be seen hereafter. Corresponding curves for iron would show more initial slope and the sharp bend marking the elastic limit would occur at a lower strain. We wish simply to call attention to the general similarity, and this would evidently be even more marked were the horizontal scale of the strain diagram somewhat exaggerated. The magnetization rises sharply till saturation is approached, when its rise is quickly checked and the abrupt turn results. The strain curve shows the same quick rise and the same sharp turn at the elastic limit. The writer, after investigation, considers these similarities mere coincidences, but they are so remarkable that he has thought it better to present the curves for the consideration of others. They in a sense strengthen the theory of "molecular magnets," which the writer considers of value in a subsidiary sense only, Sec. 19, though it has been so well studied as to appear sufficient in itself to account for most of the phenomena. It seems necessary to present the arguments in favor of this theory somewhat in detail.

Sec. 14. According to the theory of Weber the molecules of iron become minute electro-magnets, which are by the operation of magnetization swung from accidental positions more and more nearly toward parallelism. This theory considers that the magnets are subject to a kind of constraint which tends to return them to their original positions. In Maxwell's amplification of the theory the constraint is identified with molecular attraction, and this assumption agrees with the observed fact that if a moderate exciting force be applied and removed the magnets will swing back to their original positions, and the extent of the motion be sensibly proportioned to the force applied. Ewing claims that reaction among the elementary magnets themselves is sufficient to account for the phenomena, or, as understood by the writer, that on the withdrawal of the exciting force the original magnetic condition reasserts itself. (See Ewing on Magnetic Induction. Secs. 168-171.) This theory would seem to be insufficient to account for the great magnetic efficiency of the softest iron which retains no trace of permanent magnetism. All of the modifications appear to have value, but the reactions due to molecular attraction, considered by Maxwell, are considered of the greatest importance.

Sec. 15. The strain diagram, Fig. 2, appears to confirm the theory of molecular magnets as modified by Maxwell, as it can be said that in one case we have a given material subjected to external mechanical forces and in the other to the internal forces of magnetism; that the molecular attraction overcome in swinging the molecular magnets towards parallelism is represented by

the strength of the material to resist crushing and tensible forces, and that the elastic reaction due thereto measures the intensity of the possible magnetization during the initial stages, shown by the curve of magnetization, Fig. 3, up to the abrupt turn. At or about that time the molecular magnets have reached nearly the condition of parallelism, and are offering great resistance to further motion and this effect is heightened by the fact that the several molecules are being attracted toward each other, actually shortening the mass and making further motion more difficult, so that after the approach to saturation, shown by the rapid bend in the curve, Fig. 3, the only additional magnetization which can be received by the molecules is that due to their still closer approximation to parallelism, and to the results must be added the increased

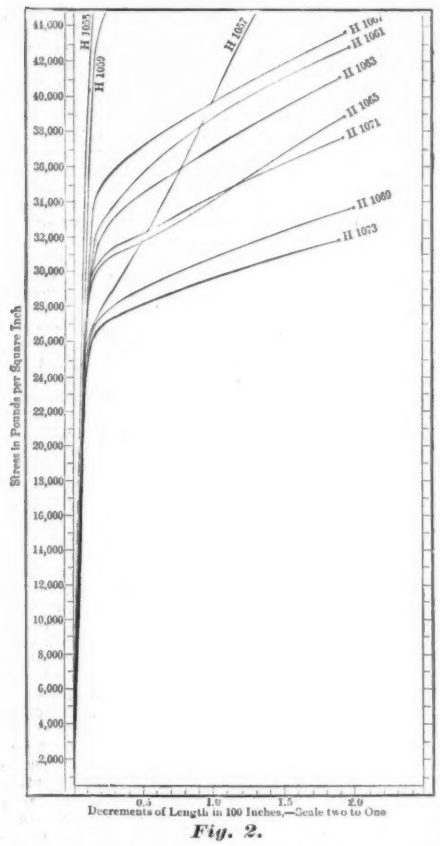



*Fig. 2.*

effect due to the flow of lines in the space occupied by the magnet considered as if no iron were present.

Sec. 16. The conception is strengthened by what we know of the physical effects shown in magnetizing iron and of the results of external forces upon magnetized iron. Villari discovered, and Prof. J. J. Thomson has elaborated the fact, that weak magnetizing forces cause iron to elongate, and that as the magnetizing forces increase the elongation is lost and an actual shortening takes place proportioned to the magnetization. The writer considers that the initial lengthening may be well explained by the fact that the molecules, lying in various directions, at first need room to arrange themselves in the same general direction, and that, therefore, the initial effort produces expansion, whereas, afterward, when such molecules are arranged approximately in the same direction, they can readily approach each other in response to the polar attraction between their adjacent ends. So, also, heating at first increases the intensity of the magnetization and afterwards decreases it, which we explain on the ground that it at first helps separate the molecules so as to facilitate their axial re-arrangement, and afterwards serves to separate the re-arranged molecules and prevent as close approximation as would be the case without the increased temperature. Again, elongation in general reduces and compression increases magnetization with a given exciting force, which corresponds with the considerations above given. Bidwell's experiments show that nickel does not have the so-called "Villari reversal" (Ewing on Magnetic Induction, Sec. 143), which does not conflict with the above explanation, as we have simply to consider that its molecules are originally arranged in proper direction. On the contrary, cobalt is affected in the opposite way to iron, which may be explained by the fact that the molecules are so differently formed that they approach parallelism better by a movement in a different direction.

Sec. 17. The forces required to deflect the molecular magnets towards parallelism during the initial rise in the curve must, on this theory, be proportioned principally to the modulus of elasticity of the iron used. It may be that the angular change in direction of the molecules must also be considered, which will complicate the problem. The other features of the curve can evidently be explained by the extreme forces necessary to deflect still nearer to exact parallelism magnets tended to be held by definite elastic forces out of parallel, and to the energy that can be stored during these reactions must be added the flow through the space occupied by the magnets as if no iron were present. The action on the molecular magnets tends to a limit, and any curve plotted therefrom must, therefore, be an asymptote, and superimposed thereupon must be the linear values due to the direct action of the exciting force in moving lines through space independent of the special qualities of the iron in such space.

Sec. 18. By carefully reviewing the considerations expressed in Sections 15 to 17, inclusive, it will be observed that in presenting the Weber-Maxwell-Ewing theory of molecular magnets and the strain diagram, Fig. 2, in connection therewith, as a means of finding a rational reason for the greater initial rise of the *H-B* curves of magnetization than is shown by the fluid function, Eq. 10, such theory of molecular magnets offers an interesting and somewhat plausible explanation of the whole phenomena without necessarily involving the theory of etheric flow. The writer, however, contends that *etheric motion of some kind necessarily follows from the phenomena of magnetic action at a distance* (Sec. 2); that magnetic phenomena rather indicate a flow than a transfer of vibrations; that the fluid function plotted in a curve shows a general similarity to an *H-B* curve and a limiting condition analogous to magnetic saturation (Sec. 9); that such fluid function, therefore, confirms the theory of translatory rather than vibratory movements of the ether to explain magnetic phenomena, and that, therefore, such function is of the highest importance as evidence to connect magnetism with ethereal flow. On the contrary, the theory of molecular magnets does not aid in the explanation of action at a distance, but is still of value to intensify the effects shown by the fluid function.

Sec. 19. Recurring to the considerations expressed in Sections 15 to 17, we may allow that the elastic reactions due to molecular attraction measure the intensity of the possible magnetization during the initial stages shown on the diagram, Fig. 3, up to the abrupt turn, but it is not believed that the highest possible magnetizing force can equal, much less exceed, the high resistance to expansion or compression shown by the strain diagram, Fig. 2. Granting the theory of molecular magnets and the swinging of the same by magnetizing forces, such swinging, resisted by such great forces as are shown by the strain diagram, must be through very limited arcs. It is believed, therefore, that the molecular magnets simply act to intensify the magnetization through the range it is possible to swing the same, and that higher magnetizations to the point of saturation are, in the main, governed by the laws of the flow of fluids exemplified by the fluid function developed above. In the "Conclusion," at Sec. 44, it is shown that the intensification due to molecular magnets may be considered in Eqs. 10 and 10*a* by simply changing the exponent of the fluid function, and a very gratifying accordance with experimental results is there obtained on such basis.

Sec. 20. In closing this branch of the subject, it will be of interest to consider how other physical phenomena can be explained if it be finally settled that magnetism is due to the circulation of an ethereal atmosphere. In such case we must imagine that the ether pervades all space, and we may suppose it susceptible to vibrations and, therefore, capable of transmitting vibratory forms of force, such as light, without interference with the phenomena or magnetism due to the circulation of its ultimate particles. This atmosphere need not necessarily be the luminiferous ether, though there is no reason why it should not be so. The etheric fluid itself may pass freely through all substances, gaseous, liquid or solid, and yet its vibration, known as light, be damped and checked by some of such liquids and solids, but flow freely in others, known as transparent. It will be more difficult to consider one mode of motion of the same ether as light and another as electricity, for both modes of motion should be damped by the same substances that dampen light, whereas, we know that light is readily transmitted through glass and electricity is not, and that electricity is readily transmitted through copper and a similar class of substances, known as conductors, which do not transmit light. If magnetism be the circulation and electricity a form of vibration of the same ether, there would be a more direct transformation of electric into magnetic force, whereas, we know that no direct transfer takes place. A magnetic flow and an electric current may be moving at the same time in the same piece of metal, an iron magnet for instance, without one modifying the other in any way.

Sec. 21. Any explanation founded on the analogy of the polarization of light should be proved from some direct transformations of electricity into light without heat. Tesla appears to be doing this, but it is believed that his results can be explained on the basis that the passage of a high potential and high frequency alternating current through a low conducting medium actually puts the ether in vibration, thus producing light as above indicated. It is believed, also, that the apparent transmission of high tension discharges through the dielectric instead of the conductor will eventually be traced to a magnetic phenomena, leaving us free to consider substantially as in the past that electrical phenomena are due to a form of motion of the molecules of solids which are susceptible to this kind of motion, like metals of the copper class, though the molecules of all substances, even of gases, and possibly of ether, are conductors in a limited sense or under peculiar circumstances.

Sec. 22. The subject has proved of great interest and has been considered of such importance that it is submitted to the profession in its present stage of progress in order that the minds of others may become occupied in the same direction and aid in the complete solution of the complex problem, using as much of the above as may survive the test of criticism and of further experiment.

## Part II.

Sec. 23. We will now proceed to the second branch of the inquiry, viz., the development of empirical formulæ to represent typical *H-B* curves of magnetization. Such curves, though empirical, will enable equations to be completed, involving varying values of $H$ or $B$, and thereby permit the application of the mathematical laws of maxima and minima, with all the important conditions of the problem included. Empirical formulæ serve also to correct errors in particular records by general comparison through the whole range of the observations, and at the same time furnish a more ready and accurate means than arithmetical interpolations to obtain intermediate values really dependent upon complex functions.

Sec. 24. Many approximate formulæ have been suggested for the purpose, of which one of the forms proposed by Frolich, of an expression developed by Lamont and others, has been most generally used. Frolich's equation, in the form

$$(11) \qquad B = \frac{H}{a + b\,H}$$

to which all the other forms may be reduced, will, with given constants $a$ and $b$, approximately represent a considerable portion of some *H-B* curves of magnetization. In Fig. 3 the application of Frolich's formula is shown in dotted lines in connection with an *H-B* curve shown in full lines for a Norway iron ring, based on experiments of Rowland in 1873 and presented in a recent paper of Mr. Kennelly.* The Frolich function contains only two constants, so that it can only be passed though any two points of a curve, and is therefore frequently unsatisfactory, except very near the points of application.

Sec. 25. The writer has found it of advantage in developing empirical formulæ to use well known curves which bear a general resemblance to the the curves to be fitted. *H-B* curves of magnetization bear some resemblance to those given by the ordinary logarithmetic formulæ, and also resemble a simple hyperbola, though the two branches are rarely symmetrical. An equation well adapted for practical use is that of an hyperbola in the form

$$(15) \qquad B = c - \frac{a}{b + H}$$

There being three constants in its equation, the resulting curve can be passed through any three points of any experimental curve by deriving the values of the constants by simple substitution.† Some *H-B* curves of magnetization may be roughly shown by one application of this formulæ, but by making one application to include the limit from $B = 0$ to some definite point above the abrupt turn, with the third point on or just below the turn, the curve will generally be accurately shown between these limits, and another application, made to three points above the higher limit, will generally show very accurately that branch of the curve. Moreover, the two curves extended will generally coincide practically for a little distance either side of the junction, and it is possible to make the first differential coefficients of the two alike and there by jointhe two curves at the same point and at the same angle and make the curve continuous, but this refinement will rarely be found necessary. No attempt is made in this connection to apply the formulæ to the sharp bend near the origin, marking the excitation necessary to cause the molecular magnets to turn toward approximate parallelism (Sec. 16), but the application can readily commence at excitations of two to three or five for soft iron and steel, respectively, and this has a rational basis, as shown in Sec. 41.

Sec. 26. The first application of this curve will be made to the experimental determinations of Mr. Steinmetz, given in one of the series of experiments made in connection with his researches on the law of hysteresis.‡ In these experiments three different samples of sheet iron were tested, one from a Westinghouse converter and the other two from iron of different thicknesses used in the Eickemeyer manufactory, and all showed a remarkable uniformity in result. The experimental values of $B$, given in Table III, p. 15, of the paper of Mr. Steinmetz, are reproduced in column 5 of Table I of this paper, and the exciting forces given in ampere turns per square centimeter in the paper of Mr. Steinmetz are here reproduced in column 1. The exciting forces in terms stated, herein designated ($H_1$), are so regularly distributed that the opportunity has been embraced to add for the purposes of comparison the corresponding number of magnetic lines per square centimeter ($H$); also the corresponding number of ampere turns per square inch ($H_2$) and the corresponding number of magnetic lines per square inch ($H_3$). There are also added in connection with the magnetizations in magnetic lines per square centimeter the corresponding magnetizations in magnetic lines per square inch ($B_2$).

Sec. 27. The equations in the form of Eq.

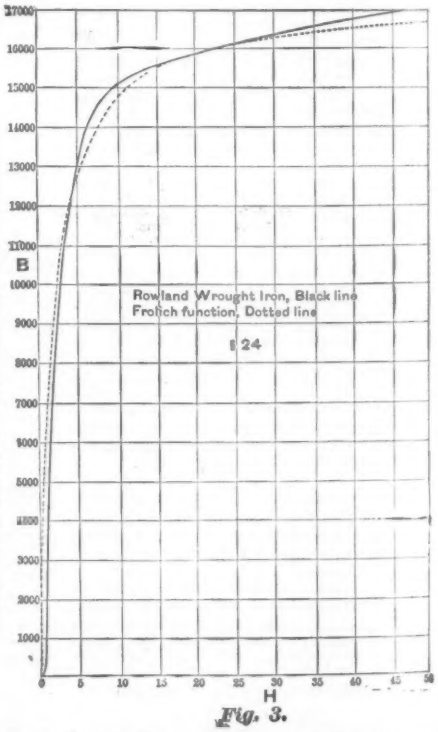



*Fig. 3.*

15 showing the magnetizations $B$ (mag. lines per sq. cm.) in terms of the exciting forces $H_1$ (amp. turns per sq. cm.) are as follows:

For $H_1$=2 to 20 (Steinmetz)

$$(16a) \qquad B = 17730 - \frac{54021}{H_1 + 1.37}$$

For $H_1$=20 to 2865 (Steinmetz)

$$(16b) \qquad B = 24908 - \frac{755962}{H_1 + 57.87}$$

*(To be continued.)*

* "Magnetic Reluctance," by A. E. Kennelly, Transactions, November, 1891, vol. viii, p. 492. If Eq. 11 in text be divided through by $B$ we have

$$(12) \qquad \frac{H}{B} = \rho = a + b\,H$$

which is the linear equation of the reciprocal of the permeability, or of the "reluctance" $\rho$, given by Mr. Kennelly. This shows that the Frolich and Kennelly formulæ are identical, though stated in different terms. The constants developed by each are applicable in the formulæ of either, and, in the application above made, the value of the reluctance for the second branch of the reluctance curve obtained from the above experiments by Mr. Kennelly is used as the denominator of the fraction in the Frolich formula, Eq. 11. Other applications are given by Frolich in his original papers, in *Electrotechnische Zeitschrift*, 1881, 1882, and by Mr. Kennelly in the paper referred to.

† It would be more rational to separate $H$ and $I$ in these formulæ somewhat as in Eq. 10*a*, but in this branch of the subject we are only seeking to fit formulæ to experimental curves, which can be done as well with the equation in its simpler form.

‡ Steinmetz on the Law of Hysteresis. Proceedings Am. Inst. Elec. Engrs., Jan., 1892.

# ADVANCE INFORMATION.

*New Electric Companies Formed and Important Constructions Projected.*

VALUABLE INFORMATION FOR MANUFACTURERS AND DEALERS.

We publish below the earliest information obtainable relating to new electric railways, new electric light companies and projected electric construction of all kinds. Every reader will find these columns of special interest, and manufacturers and supply houses will receive many valuable suggestions looking to new business by carefully watching this department in the ELECTRICAL REVIEW from week to week:

### Electric Light and Power.

PHILADELPHIA, PA.—The Fox-Chase Electric Light, Heat and Power Company will apply for a charter. Incorporators, Joseph W. Crawford, John Sibbold, M. D., Joseph Ashby, Robert T. Martin, William J. Crowe, H. B. and C. E. Rowland and Kennedy Crossin.

CREEDE, COLO.—The Amethyst Electric Power and Light Company. The capital is $200,000, with E. N. Magner, B. F. Kelley, J. P. Wallace and A. W. Brownell as incorporators and directors for the first year.

FULTON, N. Y.—The Dexter folder works and the Miller-Tooley knife factory at Fulton are to be run by electricity.

EASTON, PA.—There is talk of the erection of a water power for all electrical purposes by a company of local moneyed men and some New York capitalists.

PITTSBURGH, PA.—Bellevue Light and Power Company; capital, $10,000. Promoters, S. L. Roseburg, F. B. Fuistwalt, Joseph P. Beggs. Incorporation papers sent to O. D. Thompson, Pittsburgh, Pa.

CHARLEROI, PA.—Charleroi Heat, Light and Power Company; capital, $5,000. Promoters, J. W. Coyle, E. B. Gawthrop, Jas. R. Ryan. Incorporation papers sent to Geo. D. Quaill, 81 Diamond street, Pittsburgh, Pa.

TITUSVILLE, PA.—Titusville Electric Light and Power Company; capital, $100,000. Promoters, Frank R. Dravo, Geo. Buffington, Geo. H. Fox. Incorporation papers sent to Charles Neubert, Kittanning, Pa.

HOLLIDAYSBURG, PA.—The Hollidaysburg Electric Light and Power Company contemplates constructing an electric car line to Duncansville.

JERSEY CITY, N. J.—Spanish American Light and Power Company; capital, $4,000,000. Promoters, W. S. Johnston, New York city; H. G. Runkle, Plainfield, N. J.; R. A. C. Smith, J. F. Gibbons, New York city; G. Holmes, Jersey City, N. J. Incorporation papers sent to De Forest & Weeks, 62 William street, New York city.

DANSVILLE, N. Y.—An effort is being made to float the stock of the Dansville Electric Light and Power Company at $80 per share, the original capitalization being 250 shares, par value $100.

NEWARK, N. J. — The Citizens' Electric Light and Power Company; capital, $1,000,000. Incorporators, F. Z. Maguire, New York; F. A. Magowan, Trenton, N. J.; J. L. Kuser, Newark, N. J.; and W. C. Heppenheimer, Jersey City, N. J.

JERSEY CITY, N. J.—The People's Electric Light and Power Company; capital, $1,000,000. Same incorporators as above.

TOLEDO, O.—The Toledo Electric Light Company will rebuild its St. Clair street plant recently destroyed by fire.

GRUNDY CENTER, IA.—A proposition to bond the town for an electric light and water works plant has been carried by 167 majority.

READING, O.—The committee appointed by the Mayor recommends the establishment of a combined electric light and water works plant.

UPPER MONTCLAIR, N. J.—The Brown Developing Company, to establish plants for the generation of electricity, etc.; capital, $10,000. Incorporators, Saml. Brown, of Allegheny, Pa.; John C. McCarty, of Brooklyn; and Michael McBarron, of Boston, Mass.

ROANOKE, VA.—The Board of Public Works will receive proposals until September 5 for lighting the streets of Roanoke with electric arc lights. There are in all about 300 gas and oil lamps in use.

POINT MARION, PA.—The Point Marion Electric Light and Power Company; capital, $30,000.

MADISON, IND.—The Madison Gas and Electric Light Company has closed a contract with the Brush Company for an arc light plant, and with the Fort Wayne Jenney Company for an incandescent light plant.

PLAQUEMINE, LA.—Mr. Maunsell, of New Orleans, has submitted a proposition to light this town with electricity for the sum of $6,000.

OAK CLIFF, TEX.—The Oak Cliff Water, Light and Power Company; capital, $100,000. Incorporators, W. J. Betlerton, W. I. Addison, W. L. Diamond, Geo. W. Davis, M. J. Dart and M. L. Morris.

BRISTOL, VT.—The Bristol Electric Company will erect an electric light plant.

LANCASTER, PA.—A company is being organized for the purpose of introducing the Westinghouse electric light system in competition with the Edison Company.

### New Electric Railways.

KANSAS CITY, MO.—The Northeast Electric Street Railway Company and the People's Cable Railway Company are to be consolidated and the cable line equipped with electricity.

EVANSTON, ILL.—The Evanston City Railway Company; capital, $150,000. President, Henry Delany.

SALINA, KAN.—The Consolidated Street Railway and Light Company; to build a four mile electric railway. President, C. D. Baum.

TIFFIN, OHIO.—The city council has granted a franchise to the Electric Railway and Power Company of this city, and the work of constructing Tiffin's first electric railway has begun. A franchise will soon be granted to the Tiffin Electric Street Railway Company, and, with the electric line connecting this city and Fostoria, Tiffin will be well supplied with transportation facilities.

SPRINGFIELD, OHIO.—The Citizens' Street Railway Company and the Springfield Electric Railway Company are to be consolidated and will pass into the hands of a Philadelphia company, whose representative head is W. B. McKinley, of Champaign, Ill. The work of equipping the Citizens' line with electricity will begin immediately under the supervision of S. L. Nelson, of Defiance, Ohio.

PLAIN CITY, UTAH.—A scheme is now on foot for building an electric car line from Five Points to Plain City.

CLEVELAND, OHIO.—The Sperry Electric Railway Company, to make all kinds of electrical machinery, especially that used by electric railways. The capital is $250,000. Incorporators, Washington Lawrence, Myron T. Herrick, James Parmelee and James H. Hoyt.

ST. JOSEPH, MO.—The street railway corporations are now getting their affairs in shape so as to build an electric line to Lake Contrary the coming fall or in the early spring.

BLUE ISLAND, ILL.—The village council will shortly be called upon to pass an ordinance granting right of way for an electric street railway to connect with Harvey and Pullman.

VICKSBURG, MISS.—Chester R. McFarland and F. E. Fuller, of this city, are applicants for privilege to construct and operate an electric street railway.

NORWALK, CONN.—The Norwalk Tramway Company proposes to build an electric road from Norwalk to South Norwalk and Darien Point, a distance of four miles. President, E. J. Hill; secretary and treasurer, John O. Osborn.

PHILADELPHIA, PA.—A charter has been granted to the Philadelphia, Cheltenham and Jenkintown Passenger Railway Company, with a capital of $60,000. John H. Fow is president, and the company will proceed immediately to build an electric road from Jenkintown to this city.

CLEVELAND, O.—The East Cleveland Railroad Company is securing right of way for an extension of its road to the market house of the Sherin Street Market and Storage Company. If the right of way can be obtained the railroad company will lay two tracks, and will use the line for carrying farm products.

ABERDEEN, S. DAK.—J. L. W. Zietlow, of this city, is interested in the Black Hills Mineral Belt Electric Railway Company, organized to construct 15 miles of electric road from Deadwood to Lead and Bald Mountain.

ATLANTA, GA.—A. S. Seals has been granted a franchise by the county commissioners to build an electric railway along the Decatur Turnpike.

PEORIA, ILL.—The Peoria Heights Street Railway Company; capital, $100,000. Incorporators, Martin Kingman, Benjamin Warren, Jr., R. W. Kempshall, and others.

BARABOO, WIS.—A movement is on foot to build an electric railroad from Devil's Lake to the Dells, *via* Baraboo.

MAYFIELD, CAL.—The Board of Supervisors of Santa Clara county have granted the petition for a franchise for an electric railway through this town to the grounds of the Leland Stanford, Jr., University.

MOBILE, ALA.—The Mobile Electric Railway Company has made an application for a franchise to build, own and operate a street railway, to be operated by electricity.

TERRA HAUTE, IND.—The Terra Haute Railway Company has petitioned the common council for a 30 year franchise.

LOCK HAVEN, PA.—The Lock Haven Street Railway Company are applicants for a franchise to change its motive power to electricity.

SALEM, MASS.—The Magnet Electric Street Railway Company has been organized by W. D. Northend, E. H. Brown and other residents of Salem. It is proposed to put a new invention of E. H. Brown on the market.

DEDHAM, MASS.—Dedham, Mass., is to have in operation by November 1 an electric street railway, running from Dedham through Hyde Park to Mattapan, there connecting with the West End. The road will be controlled by the Suburban Electric Railway Company, and cars will run every 30 minutes, reaching Boston in a little over an hour.

### Change of Organization.

LYNN, MASS. — The company which will control the Naumkeag Street Railway of Salem, and the Lynn and Boston and Belt Line roads, will be called, it is said, the North Shore Traction Company, and is made up of New York capitalists, among them Perry Belmont and Jesse Seligman. The proposed company will lease the three roads for a period of 99 years. The Lynn and Boston road is said to be paying eight per cent., and the new company will guarantee the stockholders of the old road a higher percentage. A. F. Breed, of the Lynn and Boston, is named as general manager.

### Manufacturing Companies.

COLUMBIA, ILL.—Eagle Electric Company; capital stock, $7,000. Incorporators, Henry Hutch, Fred. Meyer and others.

PORTLAND, ME.—The Rumford Falls Construction and Supply Company has been organized at Portland, Me., for the purpose of manufacturing castings, machinery, mill supplies, steam, gas and water pipes, and plumbing and electric supplies, and dealing in the same, with $100,000 capital stock, of which $500 is paid in. The officers are: President, Charles S. N. Talcott, of Woonsockett, R. I.; treasurer, William H. Bailey, of Woonsockett.

CHICAGO, ILL.—The Track and Car Supply Company; capital, $275,000. Incorporators, Joseph Schneider, J. Elliott and Chas. S. Burton.

BRADDOCK, PA. — The People's Electric Company; capital, $75,000. Incorporators, J. Vance, A. T. Reid, D. D. Wilson, S. D. Hamilton and A. M. Carline.

TROY, N. Y.—The E. G. Bernard Company, to manufacture and trade in electrical and other machinery and appliances; capital, $15,000. Directors, Edgar C. Bernard, K. B. Dowsley, of Troy; and Frank L. Stevens, of North Hoosick.

JERSEY CITY, N. J.—The Acme Storage Battery and Manufacturing Company; capital, $5,000,000. Incorporators, Geo. C. Warner, C. T. Griffin and Wm. L. Barker, of New York city; Jacob Herbert Potts, of Jersey City, N. J.; and W. M. McDougall, of Orange, N. J.

CHARLESTON, W. VA.—The Mitchell-Thompson Underground Electric Conductor Company; capital, $500, privilege granted to increase to $1,000,000. Incorporators, A. C. Thompson, J. A. Ceaver, W. Q. Adams, F. L. Smith and A. T. Holcomb, all of Portsmouth, W. Va.

### Increase of Capital Stock.

SPRINGFIELD, MASS.—The annual meeting of the United Electric Light Company has been held, and the board of directors was re-elected as follows: Elisha Morgan, L. J. Powers, E. C. Rogers, John Olmsted, H. J. Beebe, C. A. Nichols and A. B. Wallace. W. A. Lincoln was re-elected clerk and treasurer. It was voted to increase the capital stock from $400,000 to $500,000. Present shareholders will be given till September 1 to take *pro rata* shares, which will be payable November 1.

ALBANY, N. Y.—The State Board of Railroad Commissioners have approved of the increase of the capital stock of the Albany railway from $750,000 to $1,250,000.

MALDEN, MASS.—The Malden Electric Company has re-elected its board of directors and voted to increase the capital stock from $150,000 to $250,000, in order to provide for a rapidly developing business.

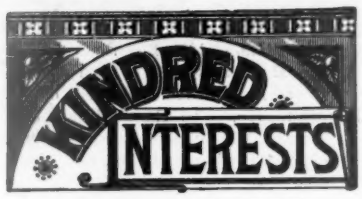
OLEAN, N. Y.—The Olean Electric Light and Power Company announces that its capital stock has been increased from $30,000 to $35,000. The amount of its debt and liabilities is placed at $16,328.43.

MAYWOOD, ILL.—Maywood and Proviso Electric Light and Power Company has certified to an increase of capital stock from $20,000 to $30,000.

WILKESBARRE, PA.—The Wilkesbarre and Shawnee Bridge Company has elected seven new directors and increased its capital stock to $300,000. This is part of the electric street car system that will control all the lines in the Wyoming valley.

WINDSOR, CONN.—The stockholders of the Eddy Electric Manufacturing Company have voted to increase the capital stock from $100,000 to $225,000, and the number of shares from 4,000 to 9,000.

PITTSFIELD, MASS.—The Stanley Electric Manufacturing Company has increased its capital stock from $50,000 to $100,000, and will at once begin the manufacture of Stanley's new alternating motor.




**The North American Phonograph Company,** Edison Building, New York, has issued a collection of convincing testimonials in pamphlet form. Recent improvements in this device render its action all that can be desired, and the company is now in such shape as to handle the phonograph commercially in a manner perfectly satisfactory to the public.

**The Conover Manufacturing Company,** New York, is sending out one of the handsomest catalogues of the season, from the press of Bartlett & Company, New York. The catalogue describes in detail the Conover independent belt and steam driven air and circulating pumps and condensers which have already been illustrated in the ELECTRICAL REVIEW.

**The Hope Electrical Appliance Company,** 108 Dorrance street, Providence, R. I., has issued a catalogue describing the apparatus which it manufactures, among which are Wright's perfected mast and arm for arc lights, Wright's metallic mast, Wright's trolley arm, Wright's positive cut-out and case, Battershall's double lever arc light cut-out and Battershall's incandescent switch.

**The Interior Conduit and Insulation Company,** New York, has received the following letter:

PHILADELPHIA, PA., August 12, 1892.

MR. E. W. LITTLE,
*General Manager,*
42 Broad St., New York.

DEAR SIR—Thinking it would be of interest to you to have a testimonial relating to the performance of your standard twin conductors at the New Neversink Mountain Hotel, Reading, Pa., during the recent and very severe electrical storm. I being an eye witness and Walker & Kepler the contractors. It was very gratifying to see the results. We have tubed the entire hotel with about 30,000 feet of the brass conduit tube and have placed the twin wire throughout the entire building.

The lightning was said to be the most severe ever seen in Racine, even by the older residents of that place, and seemed to play around and through the building in every direction, but did not affect our lines in any manner, not even so much as to blow the smallest fuses.

During the storm several of the lamps were broken by the overcharged lines, the glass being blackened as though they had been painted with black paint on the inside.

Some were bursted and cracked like little pistols when they went off. The building gets its current from the Reading Electric Light Company, whose plant is located 8,500 feet from the hotel. It is an overhead system and therefore the overcharge in such a storm would be very heavy.

Hoping that this testimonial will be of some benefit to you, I remain,

Yours respectfully,
(Signed.) I. C. WALKER.

**H. Ward Leonard & Company,** Electrical Exchange Building, New York City.—Among the contracts closed by H. Ward Leonard & Company, as bulk electrical contractors, during the past 30 days are the following:

Port Richmond Prohibition Park Railway, Port Richmond, S. I.; J. S. Kennedy's residence, Bar Harbor, Me.; New Netherlands Hotel, New York city; Racquet and Tennis Club, New York city; Delaware, Lackawanna and Western building, New York city; the Betz building, Philadelphia, Pa.; the Havemeyer building, New York city; the Continental Corset Company building, Newark, N. J.; I. N. P. Stokes' residence, New York city; the Broadway power house, New York city; the Cuyadutta Electric Railway, Gloversville, N. Y. The business secured by this concern during the past 30 days exceeds $400,000.

**The General Electric Company** has made the following new contracts: Washington, Mt. Vernon and Alexander Railway Co., Alexander, Va., for an original equipment of six cars; The City and Suburban Railway Co., Baltimore, Md., for an original equipment of 50 cars; West Street Railway Co., Elmira, N. Y., for an original equipment of six cars; Gallipolis Street Railway Co., Gallipolis, Ohio, for an original equipment of three cars; Consolidated Street Railway Co., Oskaloosa, Iowa, for an original equipment of six cars; New London Street Railway Co., New London, Conn., for an original equipment of six cars. The General Electric Co., has also made contracts for additional equipments for the following roads: Marinette Street Railway Co., Marinette, Wis., two cars; Oakland Consolidated Street Railway Co., Oakland, Cal., 10 cars; Rochester Electric Railway, Rochester, N. Y., two cars; Spokane Street Railway Co., Spokane, Wash., three cars; Streator Railway Co., Streator, Ill., two cars; Toledo Consolidated Street Railway Co., Toledo, Ohio, six cars; East Cleveland Street Railway Co., Cleveland, Ohio, nine cars; Lakeside Street Railway Co., Fort Wayne, Ind., three cars.

**The Ball Engine Company,** Erie, Pa., have shipped during the last three weeks the following: Compania Mexicana y Luz Electrician, City of Mexico, two 60 h.-p. engines and two 60 h.-p. heaters; Hot Springs Electric Co., Hot Springs, Va., one 100 h.-p. engine, one 200 h.-p. heater, two 80 h.-p. boilers and one 200 h.-p. pump; Ames-Bonner Co., Toledo, O., one 80 h.-p. boiler; Brooklyn Navy Yard, Brooklyn, N. Y., one 80 h.-p. engine; Arnold Ore Mines, Ferrono, N. Y., one 35 h.-p. engine; Northwestern Supply Co., Tacoma, Wash., one 25 h.-p. Engine; Carbon Iron Co., Pittsburgh, Pa., one 130 h.-p. engine; Diamond Light and Power Co., Sheldon, Ia., one 80 h.-p. engine; North Hudson County Railroad Co., Hoboken, N. J., one 250 h.-p engine; Puget Sound Pulp and Paper Co., Everett, Wash., one 25 h.-p. engine; Pittsburgh Iron and Steel Engineering Co., Pittsburgh, Pa., one 130 h.-p. engine; Whitman & Barnes Mfg. Co., Akron, O., one 80 h.-p. engine; Fort Clark Street Railroad Co., Peoria, Ill., one 130 h.-p. engine; Boulder Electric Light Co., Boulder, Colo., one 100 h.-p. engine; one 100 h.-p. boiler; one 150 h.-p. pump, and two 100 h.-p. heaters; Shamokin Street Railway Co., Shamokin, Pa., one 130 h.-p. engine; North Avenue Street Railway Co., Baltimore, Md., two 130 h.-p. engines; Mt. Vernon Electric Light Co., Mt. Vernon, O., one 150 h.-p. engine; H. F. Watson & Co., Erie, Pa., one 350 h.-p. Cross compound; Rock Cut Clay Co., Limited, Alfred Center, N. Y., one 60 h.-p. engine; Metropolitan Telephone Building, N. Y. city, one 60 h.-p. engine; La Gran Fundicion Nacional Mexicana, Monterey, Mexico, one 60 h.-p. engine.

## ADVANCE INFORMATION.

(*Continued from page 11.*)

### Suit Entered.

GALVESTON, TEX.—Suit has been entered at Galveston, in the United States Circuit Court, by the Detroit Electrical Works against the Galveston City Railway Company, to recover $38,002.91 with six per cent. interest.

### Consolidation.

TORONTO, ONT.—The Edison and Thomson-Houston Companies have combined. It is reported that similar consolidations will be made in all Canadian cities where these two companies are operating stations.

### Telephone and Telegraph Companies.

BROKEN BOW, NEB.—A telephone line between this place and Callaway has been suggested.

GRAND ISLAND, NEB.—Grand Island has a proposition from the telephone company to be connected with Omaha and Lincoln in consideration of $2,000 patronage tickets being taken.

PORTLAND, ME.—The Commercial Union has leased the old Somerset telegraph line and will operate it. They will have offices now at Oakland, Norridgewock, North Anson, Skowhegan, Madison, Solon, Bingham, Carratunk, West Forks, New Portland and Embden.

ELIZABETH, N. J.—The New York Visual Telegraph Company has been incorporated. The capital is placed at $100,000, and the business is to transmit news and perform other public services by means of electrical devices. James E. Brown, of Elizabeth; Wm. W. Rider, of New York; and Albert Blackburne, of Yonkers, are incoporators.

### New Electric Railways.

NEW ORLEANS, LA.—The Crescent City Railroad Company is preparing to equip its Coliseum and Magazine line with electricity.

PATERSON, N. J.—The Paterson and Little Falls Electric Railway Company, capital, $50,000, has filed articles of incorporation.

BALTIMORE, MD.—A charter has been obtained for a trolley road from Baltimore to Washington. P. A. B. Widener, president of the Philadelphia Traction Company, is interested in the project.

AURORA, ILL.—The Aurora city council has granted a franchise to the Aurora and Chicago Interurban Railway, to run from the business center of this city to Chicago, by way of Riverside, a distance of over 40 miles. Right of way is now nearly all secured, and the work of construction will soon begin. It is to be an electric road.

GLOVERSVILLE, N. Y.—The Cayadutta Electric Railroad Company has been granted permission to increase its capital from $120,000 to $350,000.

MCKEESPORT, PA.—The Citizens' Passenger Railway Company has been organized to build an electric railway through the streets of McKeesport. James S. Kuhn is president.

CHICAGO, ILL.—The West and South Town Street Railroad Company, Lawrence E. McGan, general manager, obtained a franchise, February last, to build an electric railway in this city. It has reported a mortgage to secure the issue of bonds to the amount of $500,000 with which to construct the line.

BEDFORD, PA.—The Bedford Electric Railway Company, capital, $50,000. The proposed road will be about two and a half miles in length, running through the principal streets of Bedford. The directors are John B. Robinson, Media; James B. Oliver and John N. Neeb, Pittsburg; S. K. Longenecker and John S. Weller, Bedford; and Wm. A. Stone, Allegheny.

SACRAMENTO, CAL.—W. A. Jacobs and A. D. Thompson are applicants for a franchise for an electric railway through the streets covered by a franchise previously granted to J. H. Henry.

MOUNT HOLLEY, N. J.—The Mount Holley and Burlington Connecting Railway Company has been organized with a capital stock of $100,000. The object of the company is to transport passengers and freight by means of electricity, steam or pneumatic power. C. H. Gachel, of Philadelphia; Geo. Norris, of Jersey City; and W. H. Clough, of New York city, are incorporators.

JAMESTOWN, N. Y.—A company is being formed to build an electric road along the Eastern shore of Chautauqua Lake to Mayville and Chautauqua. Both passengers and freight will be carried.

SANTA CRUZ, CAL.—J. P. Smith has purchased the stock of A. P. Hotaling in the Pacific Avenue Street Railroad Company, a controlling interest. The stock will be transferred to the Santa Cruz, Garfield Park and Capitola Electric Street Railway Company, and the motive power will be changed from horses to electricity.

SALEM, MASS.—It is reported that the Naumkeag Street Railway Company has purchased the Beverly & Danvers Street Railway and that it will be operated by the first named road, by the overhead electric system.

MILWAUKEE, WIS.—The Milwaukee Street Railway Company has been asked to build an electric railroad through Menominee Valley to Wauwatosa.

### Electric Light and Power.

BOULDER, COLO.—The Boulder Electric Light Company has filed an amendment to the articles of incorporation increasing the capital to $50 000.

INTERVALE, N. H.—H. C. Atkinson, of Portland, Me., has obtained control of the water power of East Branch Falls and proposes to use it for introducing a system of electric lighting in North Conway, Lower Bartlett and Intervale. A company is to be organized with a capital of $200,000.

CHICAGO, ILL.—Northwestern Electric Light and Power Company; capital, $25.000. Promoters, George W. Bryson, Francis M. Charlton, Percey L. Shuman. To operate electric light and power plants.

SAN FRANCISCO, CAL.—The Sonora Electric Light Company; capital, $10,000. Promoters, James Armstrong, William V. Lookwood, J. H. Harbour, of San Francisco, and C. S. Fitch, P. M. Keeffe, of Sonora, Cal.


## MACHINERY IN STOCK.

Engine Lathes, 10 in. x 4 ft.; 11 in. x 5 ft.; 12 in. x 6 ft.; 14 in. x 6 ft.; 16 in. x 6 ft.; 18 in. x 8 ft.; 20 in. x 8 ft., with tapes attachment; 22 in. x 12 ft. and 14 ft.; 24 in. and 26 in. x 16 ft.; 30 in. x 10 ft. and 16 ft.; 36 in. and 38 in. x 20 ft.; 42 in. x 12 ft.; 27 in. x 32 ft.; 28 in. x 31 ft.; 96 in. x 20 ft. Fox Lathes, 12 in. x 5 ft.; 14 in. x 5 ft.; 15 in. x 6 ft.; 18 in. x 6 ft. Turret Lathes, 12 in. x 5 ft.; 14 in. x 5 ft.; 15 in. and 16 in. x 6 ft.; 18 in. x 6 ft.; 36 in. x 8 ft.

Planers, 16 in. x 16 in. x 3 ft.; 20 in. x 20 in. x 4 ft.; 24 in. x 24 in. x 6 ft.; 30 in. x 30 in. x 6 ft.; 36 in. x 36 in. x 10 ft.; 42 in. x 42 in. x 12 ft.; 44 in. x 48 in. x 22 ft.; 60 in. x 49 in. x 24 ft.

Friction Shapers, 15 in., 16 in., 20 in., 28 in., 32 in.

Crank Shapers, 6 in., 8 in., 10 in., 12 in., 13 in., 16 in., 17 in., 20 in., 24 in., 28 in.

Screw Machines, Nos. 1, 2, 3, 4, with or without Wire Feed.

Screw Machines, Nos. 5, 6, 7, 8, Power Feed.

Presses, Nos. 51, 52, 53, Ferracute; Nos. 1, 2, 3, Stiles & Parker.

5 Lincoln Pattern Millers, No. 2.

Hand Millers, Nos. 1 and 2. 3 Cam Cutters.

Bolt Cutters, ¼ in. to 1 in., ½ in to 2 in.

2 Profiling Machines. 1 36 in. and 48 in. Gear Cutter.

C. D. and E. Horizontal Boring Machine. Newark Machine Tool Co.

Send for List of New and Second-Hand Machinery in Stock.

PRENTISS TOOL & SUPPLY CO., P. O. Box 3362,
115 Liberty Street, New York.
59 South Canal St., Chicago, Ill.

## CHANDLER, FFRENCH & CO.,

1st NATIONAL BANK BUILDING,
*KANSAS CITY, KANSAS.*

## ELECTRICAL SECURITIES.

Buy and sell Electric Light and Street Railway Bonds.

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